APRIL, 1951

VOLUME 38
NUMBER 4

plating

PLATING WASTE TREATMENT

See Contents Page 343

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Ann Arbor, Michigan

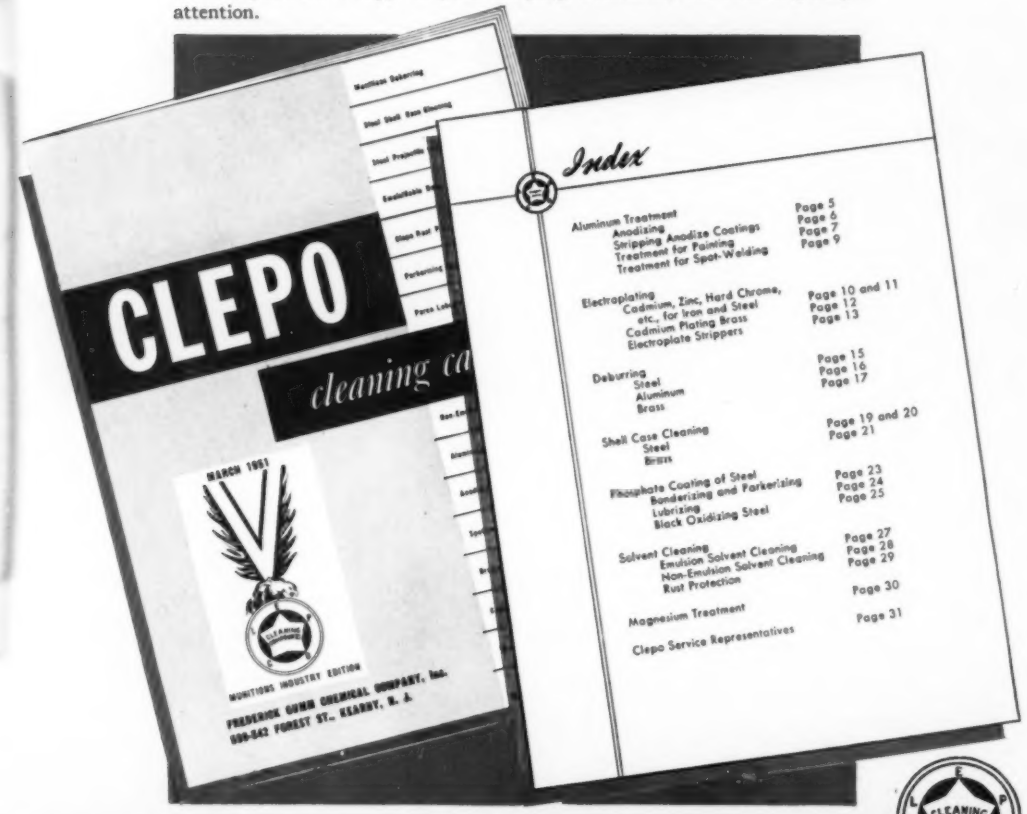
TO THE *Munitions Industry*

..send for this new 32-page booklet of up-to-date finishing information

DESIGNED for the Munitions Industry, this new manual contains information of timely interest to all concerned with metal finishing.

Whether your products are ear-marked for the use of our armed services, or for civilian applications, it will pay you to study Clepo methods. If it results in the improvement of an operation, or a reduction in cost, it will be well worth the effort.

Your request for a copy on your company letterhead, will receive prompt attention.



FREDERICK GUMM *Chemical Company Inc.*

538 FOREST STREET, KEARNY, N. J.

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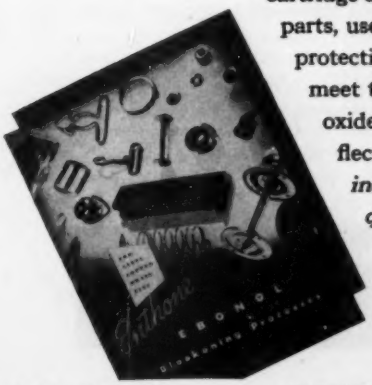
GUN AND PISTOL PARTS COURTESY HIGH STANDARD MANUFACTURING CORP.

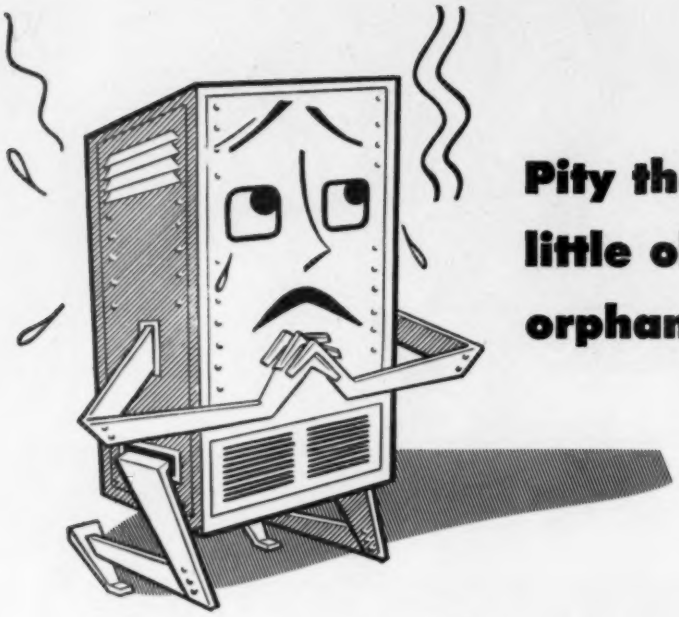
Millions of Guns...

ammunition shells, cartridge clips, shoe eyelets, buckles, buttons, harness hardware, radar parts, used in World War II, received these government-approved, protective black finishes. Enthone Ebonol blackening processes meet today's Army, Navy and Air Force specifications for black oxide coatings on steel, copper, brass and zinc . . . for wear, reflectivity, saltspray, and weathering. NEW EBONOL Booklet *including detailed operating instructions, sent free on request. U.S. Patents*—2,364,993, 2,460,896, 2,460,898, 2,481,854. Canada, 463,852.



Enthone inc

442 ELM STREET NEW HAVEN CONN



Pity the little ole orphan...

He ain't got no Papa...he ain't got no Mamma. Poor little thing. His stacks were too small, and they have broken down. His transformers are tired, and his meters never did read right. Somebody paid good money for him at one time — it might have been you — and got good and stuck.

We're talking about a rectifier which sprang from that group of opportunists who cropped up after the last international disturbance. It still has the beautiful guarantee — but there's no one left, not even the company who issued it, to make good on the guarantee.

...if you plan to take a Rectifier into your plant, make sure it comes from a healthy, happy, well-established and we-mean-to-stay family like, for instance, Green Electric, which has been making selenium electroplating rectifiers longer than anybody...

Pedigree and technical information on GREEN RECTIFIERS will be sent quickly, and without obligation, by Green Electric or their friends:

Walter R. Binai, Indianapolis • Carl Chemical Co., Seattle • Crown Rheostat & Supply Co., Chicago • W. H. Fatheringham, Buffalo • Industrial Chemical & Equipment Co., Minneapolis • Munning & Munning, Newark • Weaver Equipment & Supply Co., Houston • Allen I Williams, Denver.

W. GREEN ELECTRIC COMPANY, INC.

GREEN EXCHANGE BUILDING 130 CEDAR STREET NEW YORK 6, N. Y.

RECTIFIER (G) ENGINEERS

ALMCO

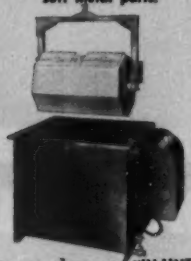
Supersheen PRESENTS

Revolutionary New

SUBMERGED FINISHING BARREL

MODEL SB-10 MAKES POSSIBLE MANY ENTIRELY NEW APPLICATIONS OF ADVANCED BARREL FINISHING

Perforated drum rotates in open tank of liquid—which provides cushioning effect in processing of soft metal parts.



For use alone—or "IN-LINE" for multiple operation processing. Drum easily moved from one tank to another—eliminating need for removal of mass from drum

New-Revolutionary SUBMERGED MASS FINISHING

- FOR LOW MICRO-INCH FINISHES
- FOR UNEXCELLED COLOR
- FOR LARGE AND SOFT METAL PARTS
- FOR CLOSE TOLERANCE PARTS

Now—manufacturers formerly "left out in the cold" by barrel finishing techniques can enjoy the savings—increased production—and better finishes provided by Supersheen's New Submerged Finishing Machine. Model SB-10 does an excellent job of heavy parts and large soft metal parts. The cushioning effect which results from complete immersion of barrel lessens impact between large parts and virtually eliminates nicking and scratching.

The new SB-10 is also outstanding for processing smaller parts requiring utmost in color and micro-finish. Variable speed drive—8 to 30 R.P.M. Write today for full details on new Model SB-10.

ALMCO Supersheen

AMERICA'S LARGEST MANUFACTURER OF ADVANCED BARREL FINISHING EQUIPMENT—MATERIALS AND COMPOUNDS

ALBERT LEA, MINNESOTA

METAL FINISHING INDUSTRIES LOOK TO ADVANCED BARREL FINISHING FOR SOLUTION OF MAN POWER PROBLEM

Manpower shortages and high-cost labor are a few of the major problems that ALMCO Supersheen advanced barrel finishing equipment is solving for manufacturers.

A single unit installation replaces from 2 to 12, men—savings run as much as 95% under former finishing methods. Many manufacturers report that ALMCO Supersheen has paid for itself in less than two months. This CONTROLLED method of barrel finishing pays off handsomely in direct labor savings, increased production and better finishes (TO ALMOST ANY DESIRED MICRO-INCH READING).

BIG NEW ADVANCES MADE IN BARREL FINISHING

ALMCO'S recent development of new barrel finishing techniques and the new super-efficient ALMCO Supersheen abrasive media and compounds now makes it possible for manufacturers in almost all metal-working fields to enjoy the benefits of the ALMCO Supersheen process.

The ALMCO Supersheen process is now used in a multitude of finishing operations—deburring, grinding, cutting down, cleaning, forming uniform micro-exact radii, improving surface finish, reducing surface porosity, finishing threaded and intricate parts, removing paint, coloring, burnishing, etc.

COMPLETE LINE OF EQUIPMENT AND COMPOUNDS

ALMCO Supersheen has the barrel finishing industry's most complete line of equipment. A large variety of barrel sizes are available from 8" x 16" to 30" x 60"—to fit almost any type of barrel finishing job. ALMCO also builds SPECIAL machines for SPECIAL jobs. ALMCO Supersheen has developed a wide range of ADVANCED compounds and abrasives for the many barrel finishing processes. These compounds have been carefully compounded through extensive research especially for barrel finishing—AND NO OTHER PURPOSE! These specially developed compounds play a very large part in achieving the finer finishes and faster processing of the Supersheen process.

FREE SAMPLE PROCESSING

Almco maintains complete sample processing and research facilities. Sample processing is done FREE! We invite your samples and inquiry.

FREE

This inside story of Advanced Barrel Finishing. 20 pages of facts and figures. Write for Booklet No. C-4

MAIL COUPON NOW!

ALMCO Supersheen, Albert Lea, Minn.

☐ Also send copy newest catalog.

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CITY _____ STATE _____

Nordall* Is Wyandotte's New Emulsion Cleaner

THERE'S lots that's new about Nordall. Nordall hits a new high in emulsion detergency with a new low in cost. It's new in safety, too.

Nordall was designed for pressure spray washers, but it's also good for immersion or soak type cleaning. Try it, too, for cold cleaning of large equipment. Your Wyandotte Representative will be glad to suggest concentrations.

*Trade-mark

NORDALL

- Reduces evaporation loss with low volatility solvents
- Inhibits rust on ferrous metals
- Will not corrode any common metal
- Is stable in slightly acid, neutral or alkaline water
- Is stable at all normal operating temperatures
- Holds emulsion longer—floats soils out
- Is non-flammable, non-toxic

THE WYANDOTTE LINE—products for burnishing and burring, vat, electro, steam gun, washing machine and emulsion cleaning, paint stripping, acid pickling, related surface treatments and spray booth compounds. An all-purpose floor absorbent: Zorball—**in fact, specialized products for every cleaning need.**

Wyandotte Chemicals Corporation
WYANDOTTE, MICHIGAN
Service Representatives in 88 Cities

Wyandotte
REG. U. S. PAT. OFF.

Industry News

Ten Wyandotte Chemicals Representatives recently attended the first of a series of 1951 product-application schools at the Company's laboratories in Wyandotte, Mich. During the week, demonstrations and discussions covered cleaning-material application in all types of metal-working and finishing operations, as well as cleaning and maintenance operations in the railroad and aircraft

industries. Discussions were led by members of Wyandotte Chemicals Research and Technical Service Departments. Numerous results of field tests of new products and case histories of actual plant operations were studied. The group is shown inspecting the model of Wyandotte's new Research Center, now under construction. The new industrial laboratories are to be located in the wing toward which Dr. R. E. Heath is pointing.

Minnesota Mining and Manufacturing Company will continue to meet its customers' needs with little difficulty despite an explosion in part of the mineral plant in St. Paul, Minn., on February 8. Eleven perons died as a result of the explosion, and 49 were injured.

Electrochemical Society's Washington Convention, April 8-12. Over 120 papers will be presented at a number of sessions on Electric Insulation, Luminescence, Rare Metals, High Temperatures, and Electrode Kinetics. The latter subject will be dealt with on April 9-10 by 20 authors from this country, Italy, France, South Africa, Australia, England and Germany. Headquarters will be in the Wardman Park Hotel, Washington, D. C.

Ward Leonard Electric Company, Mount Vernon, N. Y., has announced the establishment of an Industrial Chrome Division, with William G. Dawson as

Published monthly at 5800 N. Marvine St., Philadelphia 41, Pa. Entered as second class matter July 1, 1946, at the Post Office at Philadelphia, Pa., under Act of August 24, 1916. Subscriptions: Domestic and Canada, $4.00 for 1 year, $7.00 for 2 years 50c per copy; Foreign, $8.00 per year, $1.00 per copy.

NOW . . . THE NEW SENSATIONAL

MICCROWAX

SELECTIVE STOP-OFF

ODORLESS...WILL NOT CRACK

- **MICCROWAX Stop-Off C-562**

  For Selective Hard Chromium Plating

- **MICCROWAX Stop-Off C-600**

  For All Plating Cycles

Amazing Results with MICCROWAX

MICCROWAX is a revolutionary, new, single-material wax for selective stop-off that is especially suited for masking on complicated parts and sharp edges.

MICCROWAX is an odorless wax that will not crack and may be readily melted for use by any common heating medium.

MICCROWAX shows a remarkable degree of adhesion, even when used on flat surfaces. It requires no prime coat before application which means only one dip tank is necessary for the complete operation.

MICCROWAX hardens immediately after the part is dipped thereby minimizing preparation time and speeding production of parts before plating.

Write for detailed bulletin

MICHIGAN CHROME *and Chemical Company*

6351 East Jefferson Avenue • Detroit 7, Michigan

MICCRO Products

Developed and Manufactured by Experianced Platers

manager. The division is engaged in the development and manufacture of chromium plating units, solutions, and processes for industrial hard plating of machine-tool accessories and component parts.

Exclusive license for the manufacture and sale of the chromium plating solution and plating unit used in the process was recently obtained by the company from Chromecraft Corporation, Chicago, Ill.

Maas & Waldstein Company, Newark, N. J., held a 3-day National sales conference on January 5-7. Of special interest was the announcement by J. L. Ledeen, Manager of Sales for the Plextone Division, that this new product—said to be the original multi-color one-coat finish—had been widely accepted.

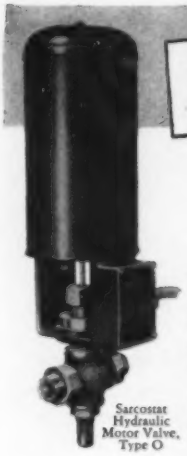
He outlined its application to a great variety of civilian and defense items.

Maas & Waldstein is now celebrating its 75th Anniversary.

Mutual Chemical Company of America has announced the completion of a new chromium chemical plant to increase the production of sodium bichromate and other essential chromium compounds. The new plant is located on the Baltimore harbor, adjoining facilities constructed previously, and is the largest and most modern chromium chemical plant in the world. As shown in the accompanying air view of Mutual's Baltimore property, the largest of the new structures on the right is the sodium bichromate plant. In the new building in the left foreground, other chromium chemicals are manufactured from sodium bichromate.

Operations have already commenced in the new plant and are expected to reach progressively higher levels over the next few months. The demand for chromium chemicals has been exceptionally heavy, and, partly as a result of extended soda ash strikes in 1950, output of the industry has not been able to meet all demands. The new capacity will be most helpful in assuring adequate supplies of chromium chemicals.

Richardson-Allen Corporation, 116-15 Fifteenth Ave., College Point, Long Island, N. Y., manufacturer of low-voltage selenium rectifiers for the plating industry, has incorporated a Canadian company under Dominion charter to manufacture, insofar as is possible, the firm's complete line for that expanding market. The Canadian company, **Richardson-Allen of Canada Limited,** is located at 370 Victoria St., Toronto. Wesley S. Block, Jr., is President and Cecil E. Brigham is Vice-President. Both held the same positions with the parent company. The operations of the Canadian company will be under the direction of the Secretary,



Sarcostat Hydraulic Motor Valve, Type O

Better Valves

for the Metal Finishing Field

At last a powerful, electrically operated control valve which does not depend on pilots, gear trains or levers.

The new Sarcostat, type O_2 is actuated directly by oil pressure on a plunger hermetically sealed in an oil chamber. A 1/100 HP motor drives a small pump to create the thrust. It has a stroke of one inch and will operate valves, single seated to 4", double seated to 8".

Valve bodies are available also in piston or needle types. Actuated by ordinary two-wire thermostats, pressure stats or push button switches.

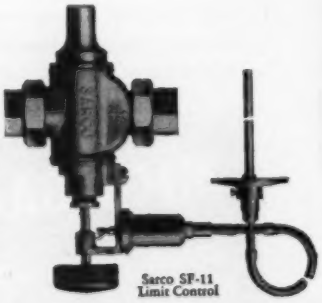
Ask for Bulletin 1082.

Degreaser Safety

Another interesting development is the self-operated Sarco type SF 11 limit control for vapor degreasers.

Should the vapor line rise above the desired level, a liquid-filled thermostat trips shut a valve in the steam or gas supply to the solvent heater. Escape of vapor over the top of the tank is thus prevented. The valve remains shut until manually reset. Available in sizes ½" to 2½", for temperatures to 350°F and pressures to 100 psi.

Full information in Bulletin 651.



Sarco SF-11 Limit Control

700

SARCO SAVES STEAM

IMPROVES PRODUCT QUALITY AND OUTPUT

SARCO COMPANY, INC.

Represented in Principal Cities

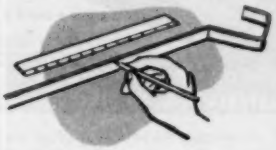
Empire State Building, New York 1, N. Y.

SARCO CANADA, LTD., TORONTO 2, ONTARIO

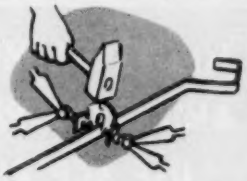
DRIVE-ON SADDLE TIPS ARE Terrific!

WOW!

all you have to do is:



1 Measure and mark Spline

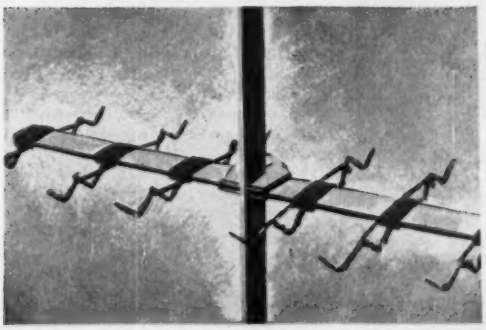


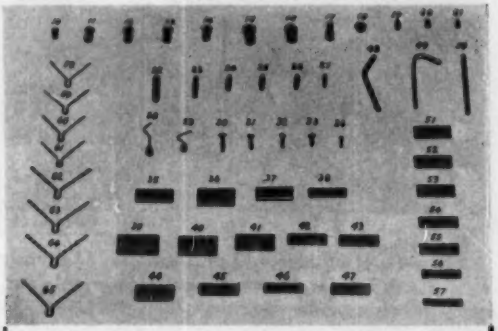
2 Drive-on STANDARD Saddle Tips *

*Patent applied for.

Eliminates expensive shop time used to bore and adjust splines

SAVES TIME...SAVES MONEY...HOLDS FIRM





Rides the Spline like a Cowboy

Standard Plating Rack Company

1913-25 N. PAULINA STREET, CHICAGO 22, ILL.
Phone: ARmitage 6-6766

The most modern and efficient rack producing plant in the world
WE CAN FURNISH PARTS FOR YOUR ASSEMBLY OUT OF STOCK

MAIL THE HANDY COUPON NOW FOR MORE INFORMATION

STANDARD PLATING RACK CO. *P
1913-25 N. Paulina Street, Chicago 22, Illinois

Gentlemen: Yes, I am interested in STANDARD SADDLE TIPS. Please have your sales representative call, with a sample of this new—easy-to-use drive on Saddle Tip at no obligation to me.

Name .....

Company ..... Position .....

Address .....

City ..... State .....

Write in for your copy of our New 1951 Catalog on Schaffner's Buffing Compounds and Supplies

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 263.

FOR EXTRA METAL PROTECTION AND EXTRA PAINT DURABILITY ...USE ACP RUST PROOFING CHEMICALS AND PROCESSES.

STANDARD RUST PROOFING PRACTICE THE WORLD AROUND

CHEMICALS ACP PROCESSES

For over 1/3 of a century, ACP has pioneered in the development, manufacture, sale and servicing of protective metal-working chemicals. These chemicals preserve the metal and the paint finish of both industrial and military products. Write or call for information about ACP Rust Proofing Chemicals and Processes and how they can improve your own products and production quality.

ACP Chemicals Meet Government Specifications

Pioneering Research and Development Since 1914

AMERICAN CHEMICAL PAINT COMPANY

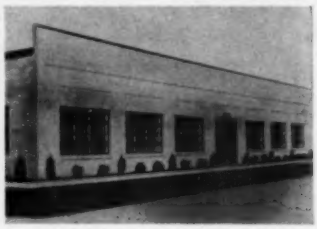
AMBLER, PA.

Manufacturers of METALLURGICAL, AGRICULTURAL and PHARMACEUTICAL CHEMICALS

Industry News

Kergan Wells, a Canadian resident already known to the plating industry in Canada.

Detroit Surfacing Machine Company has secured larger quarters at 1133 E. 8 Mile Road, Detroit 20, Mich. The reception of its Model DF, Detroit Easy



Finisher, introduced in 1949 for hand-finishing of wood, plastic and metal, made this move necessary.

Lead and Zinc from Smelter Waste Piles. A wartime process for the recovery of these strategic metals from smelter waste piles is proving such a success that a third installation is now being built. In this process, developed by Babcock & Wilcox Company, zinc and lead, in the form of vapor or fumes, is "fumed" from the surface of a furnace-load of molten slag. The vapor is converted into a metallic oxide known as "fume" for further processing into finished metal.

The first installation was made in 1943 at Kellogg, Idaho, by the Bunker Hill & Sullivan Mining Company; the second in El Paso, Texas, for the American Smelting & Refining Company. The latest installation is near the Arctic circle at Flin-Flon, Man., where the Hudson Bay Mining & Smelting Company has an 800,000-ton accumulation of residue estimated to contain 26 per cent of zinc alone.

American Chemical Society Diamond Jubilee. In celebration of its 75th anniversary, the A. C. S. will hold its Diamond Jubilee Meeting in New York City on September 3-7.

Dr. William Blum of the National Bureau of Standards has been appointed by President W. J. Neill to represent the

CHEMICAL ENGINEER

Thoroughly experienced in all types of electroplating processes and control. Also metal cleaners and buffing compositions.
Ferrous and non-ferrous metallurgy, lacquers, enamels, detergents, and specialties.
Formulations, development, and technical service experience. Available full time or consulting. Excellent references. *Reply to:*

P-451-A, PLATING
P. O Box 168, Jenkintown, Pa.

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PENNSALT CHEMICALS METAL CLEANING DIGEST

for men interested in Metal Cleaning Economies

SAVING ALKALINE CLEANERS
5 SENSIBLE RULES

by Robert H. Tiers
Whitemarsh Research Laboratories
Pennsylvania Salt Manufacturing Company

Now more than ever, operators of metal cleaning equipment must practice good management of their equipment and supplies. This includes good housekeeping, careful control of solutions, and proper use of available or substitute materials.

The rules outlined below are good any time . . . but right now they are especially important if production is to be maintained or increased. Adapt these suggestions to your own shop.

1. USE DOUBLE-TANK CLEANING. By using two tanks for cleaning, most of the heavy grease and soil are left in the first tank. Then the second tank can clean the parts more thoroughly and rapidly. Further savings can result by transferring the second tank's solution to the first when the first tank is exhausted, rather than dumping both at the same time.

2. SAVE CLEANER by raising bath temperatures, using cleaner at lower limit of concentration, and reducing dragout. Accurate control of pH and additions should be maintained.

3. SKIM OFF surface of the cleaning bath. This reduces contamination of cleaned parts, and removes adverse surface effects. A handy "sweep" can be made from a piece of canvas tacked to a stick. Avoid skin contact with the hot solution.

4. USE ANHYDROUS CLEANING COMPOUNDS. Use of cleaners with high active ingredient content will save space, time and containers. Control is easier with the smaller additions necessary.

5. MAINTAIN EQUIPMENT. Check your pressure and temperature controls, valves, spray nozzles on spray or rinse equipment, electrical contacts. Descale tanks with specialty acid cleaner for best heat transfer efficiency. Check for leaks, dragout and slop losses. Recover any "lost" parts from bottom of tanks.

On-the-spot consultation with an experienced Pennsalt technical service man will often point up other possible savings with your existing or proposed cleaning cycle. Check "A" on the coupon for name of your nearest Pennsalt man and a reprint of these conservation rules.

Have you sent for Pennsalt's NEW Metal Cleaning Bulletin?

Here's a brand new bulletin put out by Pennsalt, which deals with the heavy duty cleaning of ferrous metals. In it, you'll find sections on soak tank cleaning, spray cleaning and electrolytic cleaning, as well as a wealth of other ferrous metal cleaning facts. This new bulletin was written concisely and to the point especially for the busy man, yet carries plenty of detail to help the newer men in your shop.

(For a copy check "C" on the coupon)

TANK FOR PICKLING STEEL

Typical construction of tanks used by "The Nation's largest hot-dip galvanizing shop."

Tank lined with double course acid-brick, laid entirely with Penchlor Acid-Proof Cement, one of Pennsalt's broad line of acid-alkali-solvent resistant cements. Penchlor Cement will give thorough protection against severe corrosive action of 10% sulfuric acid at 180°F., and withstands the physical abuse resulting from submerging and withdrawing steel plates.
(For further information on Penchlor, check "B" on the coupon)

PENN SALT

PENNSYLVANIA SALT MANUFACTURING CO.
WIDENER BUILDING • PHILADELPHIA 7, PA.
Progressive Chemistry for over a Century

Mail this coupon for more information on

"A" ☐ "B" ☐ "C" ☐

Name_____

Company_____

Address_____

City_____ Zone____ State_____

FULL LENGTH "CONDUCTA-CORE" INCREASES CONDUCTIVITY, RIGIDITY

Federated Conducta-Core Lead Anodes have a highly conductive and non-contaminating 3/8" diameter aluminum rod running from top to bottom. This, together with the unique design of the anode, assures complete rigidity . . . there is no curling, buckling or peeling to interfere with automatic plating operations.

The Conducta-Core makes every inch of the anode highly and uniformly conductive . . . more current can be carried than by ordinary anodes. Another advantage of the Conducta-Core Anode is the great number of high projections that give it greater-than-average throwing power.

No need to worry about anodes dropping into the tank because of corroded hooks . . . an improved lead coating 3/16" thick at the base of the copper hook is your guarantee of permanently attached anodes.

Federated Conducta-Core Anodes are available in all standard lengths up to 52 inches, and with a variety of hooks. Special sizes made to order. Flat Rolled and 3-Rib Lead Anodes can also be supplied.

Federated Metals Division

federated first in the non-ferrous field FMD

AMERICAN SMELTING AND REFINING COMPANY • 120 BROADWAY, NEW YORK 5, N. Y.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 266.

Industry News

American Electroplaters' Society at the ceremonial session on September 5. He has been a member of the A. C. S. for forty-eight years and of the A. E. S. for thirty-seven years.

The twenty technical divisions of the A. C. S. are organizing symposia to be held throughout the week. The week following, the International Union of Pure and Applied Chemistry will hold its meeting and the week after that the International Congress of Pure and Applied Chemistry, both in New York City, with a large contingent of foreign scientists in attendance.

Manufacturers Support Philadelphia Branch Plating Course. The Philadelphia Branch has long promoted courses in electroplating in local schools. Among teachers of such courses have been Dr. A. K. Graham, now A. E. S. Executive Secretary, and Mr. Albert Hirsch, an Honorary Member of the Society. The present course, at Temple University, is being taught by Dr. S. Heiman, President of the Branch.

In response to an appeal for apparatus for use in the course, the Lea Manufacturing Company has donated a Lea Lectromag, and American Instrument Company, an Aminco-Brenner Magne-Gage. The Branch greatly appreciates this help.

Empire Solvents, Inc., manufacturer of chemicals for black oxide finishes on steel, has moved its plant to Clifton, N. J. Its general offices and laboratory are located at 153 E. 26th St., New York 10, N. Y.

Film on Automatic Control. Making use of the "pictorialized lecture" technique, the Instrument Society of America has just completed a fifty-five-minute recording of "Principles of Automatic Control", in full color and sound, 16-mm. This movie can be shown by engineering groups and schools. Copies of the film can be purchased by companies for their own training programs.

A leaflet, which includes a detailed description, can be obtained by writing to the Instrument Society of America, 921 Ridge Ave., Pittsburgh 12, Pa.

WANTED

Manufacturer's Agents in certain areas to sell McKEON'S "ZINC BRITE," world's most effective cleansing and purifying agent for cyanide zinc plating solutions. Liberal commission. Excellent cooperation. *Write:*

SULPHUR PRODUCTS CO.
Greensburg 8, Pa.

BRIGHT FINISHING SYSTEM

SPARKLES

LIKE CHROME!

Leading manufacturers approve zinc plate and IRIDITE *Bright to replace conventional chrome plating*

If your problem is finding the right finish to replace conventional chrome plating, follow the lead of prominent manufacturers of all types of products . . . switch to zinc plate and Iridite Bright.

Here's what you get when you use this chromate finishing system to replace conventional chrome plating.

SPARKLING BRIGHT APPEARANCE

The zinc plate and Iridite Bright system resembles chrome so closely that visual inspection can scarcely tell the difference! And, the brilliance *lasts.*

BETTER CORROSION PROTECTION

Yes, you actually get better protection with zinc plate and Iridite Bright than with chrome plating . . . up to twice the life under accelerated salt spray conditions! And, by applying a clear baking lacquer over the Iridite coating you can increase the abrasion resistance and lasting qualities of this bright finishing system, at the same time making possible a greater salt spray protection.

LOWER FINISHING COSTS

One metal, zinc, replaces three so you save material costs and plating time. Iridite Bright goes on in a non-electrolytic chemical dip.

Write or call today for your copy of our new Technical Bulletin describing all phases of this bright finishing system in detail. Tell us your bright finishing requirements. If possible send sample parts for test processing.

Iridite is approved under government specifications

ALLIED RESEARCH PRODUCTS
INCORPORATED
4004-06 E. MONUMENT STREET • BALTIMORE 5, MD

REPRESENTATIVES IN PRINCIPAL INDUSTRIAL CITIES; West Coast: L. H. BUTCHER COMPANY
Manufacturers of Iridite Finishes
for Corrosion Resistance and Paint Systems on Non-Ferrous Metals; ARP Plating Chemicals.

Personals

Dr. W. Blum, Chief of the Electrodeposition Section of the National Bureau of Standards, was awarded the Gold Medal of the Department of Commerce on February 15. The accompanying citation stresses his influence in changing the electroplating industry from one primarily built on empiricism to one based on organized knowledge obtained by research.

Dr. Blum was recently elected an honorary member of the Electrodepositors' Technical Society of London, England.

Ambrose L. Moll has been elected Treasurer of The Atlas Mineral Products Company, Mertztown, Pa. Now Office Manager, he joined the organization 22 years ago.

Earl Erich, formerly of the Technical Service Department, has been made Product Director for Linings and Coatings.

George Kanelis, recent chemical engineering graduate from the University of Syracuse, has joined the Engineering Department.

John W. Nestor is now Assistant Manager of the Finishes Division of the duPont Company, succeeding the late **M. A. Dibble. Joseph B. Dietz,** former Manager of Industrial Sales, has become Assistant Director of Sales, and **William P. Fisher,** formerly Assistant Manager of Industrial Sales, has become Manager.

Mr. Nestor, originally from Parsons, W. Va., joined duPont in 1927 after being graduated from the University of West Virginia in chemical engineering. After working as a chemist at the Parlin and Philadelphia laboratories for 12 years, he went into industrial sales in the Chicago region and later became manager for the Chicago region. He came to Wilmington in 1944 as Assistant Manager of Industrial Sales, and became Assistant Director of Sales in 1945.

Mr. Dietz is from York, Pa., and a graduate of Lehigh University in chemical engineering. He joined duPont at the Philadelphia paint plant and laboratory in 1924.

Mr. Fisher, a native of Unionville, Pa., is a graduate in chemical engineering of Massachusetts Institute of Technology. He joined duPont at Parlin, N. J., as a chemist in 1926.

Lawrence V. Nagle, Vice-President and National Sales Manager of The Udylite Corporation, was recently elected to the Board of Directors of the firm. He has been associated with The Udylite Corpora-

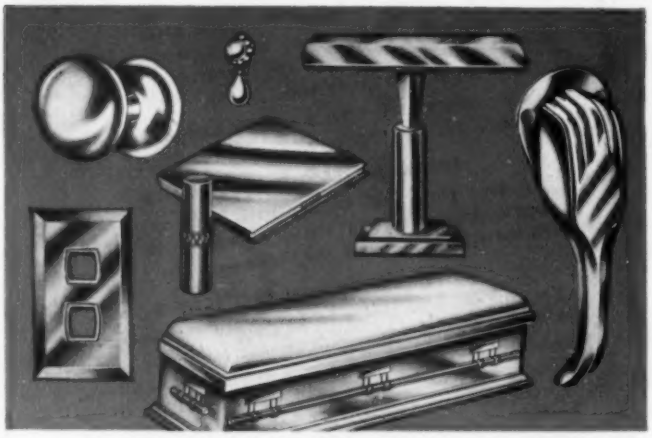
Nagle

tion since 1927, when he started as a salesman in the Detroit area for this manufacturer of electroplating equipment. He was appointed Michigan Sales Manager in 1938 and put in charge of national sales in 1944.

Yellott F. Hardcastle of Easton, Md., died suddenly in Presbyterian Hospital, Philadelphia, on February 4. He was 67 years old. He was graduated from Lehigh University as an electrometallurgical engineer in 1905 and then worked briefly as a smelting engineer in Mexico and the Southwest. In 1909 he joined the engineering department of the Pennsylvania Salt Manufacturing Company's Wyandotte, Mich., plant and served as draftsman and supervisor of the electrolytic operations there until 1915 when he became Superintendent. In 1928 he became Vice-President in charge of Manufacturing, a position he held until he retired in 1949.

Dr. S. Wernick has been awarded the Gold Medal for 1951 by the Electrodepositors' Technical Society, England. The Medal, which represents the highest award in the gift of the society, will be presented at its Annual Conference at Torquay in April.

Dr. S. Wernick is the Honorary Secretary, Chairman of the Publications Committee, and a Past President of the Society. He has carried out and directed considerable research in the electrometallurgical field, which has led to numerous publications. He has specialized in metal



NOW...simulate copper, brass and bronze on products like these with M & W PLATELUSTRE

Don't let critical metals put a *needless* crimp in your production!

Take zinc or steel—apply a coating of one of the new PLATELUSTRE finishes. You wind up with products and parts that look so much like copper, brass and bronze that *the eye can scarcely tell the difference!*

Whether you have been using now unavailable copper and its alloys for *making* products or for *plating* products, you will find these new M & W finishes *equally* effective in keeping your plant running. There are types for air-drying and baking schedules—pick the one that best fits *your* production requirements.

Let an M & W Technical Service Engineer show you—*right in your own plant*—how easy these PLATELUSTRE coatings are to use, and what striking effects they produce. Or, if you prefer, write for free literature.

PIONEERS IN PRODUCTION

75th ANNIVERSARY 1876

MAAS & WALDSTEIN CO. NEWARK 4, N. J. CHICAGO 12, ILL. LOS ANGELES 34, CAL.

PACIFIC COAST DIVISION: SMITH-DAVIS CO., 10751 VENICE BOULEVARD, LOS ANGELES 34, CAL.

MANUFACTURERS OF INDUSTRIAL FINISHES

A Statement about Modern Tumbling

De-burring and finishing metal parts by tumbling with chips and compounds in specially designed machinery is a relatively new process. This technique was initially developed just prior to World War II, and was designed primarily for finishing parts preparatory to plating. The effects of chips and compounds on different metal parts were studied through a trial and error effort. Surprisingly good finishes were obtained which could be duplicated uniformly.

Successful grinding and finishing were performed on steel, brass, aluminum, stainless and nickel steels—on castings, forgings, stampings, and machined parts. Uniformity on quantity lots was attained from severe grinding to fine finishing. Likewise, a more uniform surface finish was obtained and dimensions were held to close tolerances. Besides producing a superior finish on most work, the process indicated tremendous savings in direct labor.

Tumbling Aids World War II Production

It was at about this same time that manufacturers became occupied with defense, and, shortly later, war production. Tumbling was a natural answer to the extreme demands put upon producers to step-up de-burring operations. The faster tempo of increased manufacturing could not be satisfied by old fashioned, hand applied methods. Tumbling with chips and compounds broke this bottleneck, because it could do the job not only faster with less labor, but could do it as accurately or more so than by hand. Standardized procedures were established, based on the experience of using certain types and sizes of chips, and various compound preparations on different kinds of metal parts. Savings were made over hand methods by as much as 80% on work for aircraft, electronic, naval, munition, and military vehicle production.

Grav-i-Flo Offers Improved Tumbling

Grav-i-Flo now offers the first big advancement in modern tumbling with new equipment and materials that increase direct labor savings over previous tumbling methods. New Super-Brite chips and specially designed machinery cut both ferrous and non-ferrous metals 25% to 40% faster, handle 30% more work load in the same floor space, eliminate subsequent operations as ball burnishing. New compounds change chip surface from finishing to cutting in minutes, and eliminate need to transfer parts from machine cylinder.

Investigate Grav-i-Flo Now!

By employing the Grav-i-Flo process, manufacturers will achieve even greater savings in de-burring parts for defense items than in the former preparedness program. Those producers handling defense contracts should investigate the possibilities of Grav-i-Flo for their work. The Grav-i-Flo Corporation will process samples free to show how your parts can be deburred at substantial savings! Send samples direct to The Grav-i-Flo Corporation.

TUMBLE GRAV-I-FLO FINISH

THE GRAV-I-FLO CORPORATION

Dept. P-3 400 Norwood Avenue

STURGIS, MICHIGAN

ABRASIVE EXPERT helps customers at one of the new 3M Demonstration Rooms.

Grinding problems? Bring them to a 3M Demonstration Room!

Grinding costs too high, production too slow? You can get fast, *expert* help at the nearest 3M Demonstration Room, staffed with 3M Methods Engineers.

Skilled operators will grind samples from your production line, work out new methods and recommend the type of coated abrasive that's best, most economical for the particular job.

Come in anytime with any kind of problem—from heavy grinding to fine finishing. Chances are we can assist you. 3M Demonstration Rooms: Boston, Chicago, Cincinnati, Cleveland, Detroit, Grand Rapids, Los Angeles, New York, Philadelphia, St. Louis, St. Paul, San Francisco, and Seattle. Send the coupon below for further information.

Minnesota Mining & Mfg. Co., Dept. P-451
St. Paul 6, Minn.

3M ABRASIVE BELTS

☐ Please have a 3M Methods Engineer call.

☐ Please send copy of new "Step Up Production" booklet explaining the 3M Method of Grinding and Finishing.

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Firm.....

Address.....

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Made in U.S.A. by MINNESOTA MINING & MFG. CO., St. Paul 6, Minn., also makers of "Scotch" Brand Pressure-sensitive Tapes, "Scotch" Sound Recording Tape, "Underseal" Rubberized Coating, "Scotchlite" Reflective Sheeting, "Safety-Walk" Non-Slip Surfacing, "3M" Adhesives. General Export: Durex Abrasives Corp., New Rochelle, N. Y. In Canada: Canadian Durex Abrasives Ltd., Brantford, Ontario.

Personals

finishing for the automobile industry. A graduate of London University, Dr. Wernick is a Fellow of the Institution of Metallurgists. He is consultant to a number of leading industrial concerns.

Herbert W. Marx and **Calvin E. A. Solla** have joined the sales force of Hanson-Van Winkle-Munning Company. Mr. Marx attended Michigan State College for three years, majoring in engineering.

Marx **Solla**

His formal education was interrupted by service, for over two years, with the Marine Corps. In 1946 he worked in the metallurgical laboratory of a large automobile company performing metallographic examinations and physical tests. Later, he was in charge of both the experimental and the tool-and-die heat-treating department. He will make his headquarters in Detroit.

Mr. Solla is a native of Bristol, Pa. He served two years with the U. S. Army and later attended Lafayette College, Easton, Pa., graduating in 1950 with a B.S. degree. His headquarters is in Boston, Mass.

G. Millard Whitney was recently appointed Manager of Wyandotte Chemicals' Syracuse district. He joined Wyandotte in 1940 as a Baltimore representa-

Whitney

tive. **George J. Lawrence** has been Wyandotte Chemicals' Syracuse manager since 1933 and is retiring under the Company's pension plan. Mr. Lawrence joined Wyandotte in 1912.

R. W. Brisky, of the Arthur B. Sonneborn Company, is now the representative of The Electric Products Company in Grand Rapids, Mich. He will handle the sale and application of the E. P. line of

JETAL BLACK

* THE *Best* FOR FERROUS METALS!

The Jetal Process

EASY TO INSTALL!

EASY TO USE!

The JETAL PROCESS is a simple, inexpensive immersion method for blackening ferrous metals by oxidation.

JETAL is an attractive finish, subdued or lustrous as desired, and also an excellent base for lacquers, varnishes and other organic coatings, improving adhesion and retarding undercoat corrosion.

JETAL increases wear resistance and toughness of ferrous metals, because JETAL oxidized surfaces have increased affinity for lubricants, therefore develop less friction.

JETAL with supplemental JETOIL treatment protects against corrosion. Salt spray ratings of 25 hours are commonplace with a 5 minute JETAL treatment, 80 hours with a two-bath process.

JETAL does not affect dimensions or surface texture because it is an integral part of the metal itself.

Weld them, solder, bend, cut, punch, stamp or roll them, JETAL treated metals won't chip, scale or peel. Alkali, solvents or high temperatures can't hurt a JETAL treated surface.

The JETAL PROCESS (U. S. Patents 2077450 and 2148331) requires only one chemical — JETAL FLAKES. A mixture of alkali and oxidizing agent carefully balanced to provide fool-proof blackening.

***JETAL-TREAT THESE PARTS FOR JET BLACK PROTECTION**

Aircraft parts, automobile parts, axles, bearings, bits, bolts, bottle caps, box strapping, buttons, bushings, carburetors, cutting tools, cutlery, die drills, engines, fans, farm implements, firearms, gaskets, gauges, locks, magnetos, nails, needles, nuts, clips, instruments, printing machinery, propellers, pumps, scales, screws, scissors, sewing machines, steel furniture, typewriters, toys, staples, tacks, tubing, sheet steel, vacuum cleaners, radio parts, household appliances, telephone parts, wire products, cartridges, shells, hardware.

JETAL COST ESTIMATE:

Only $1.00 for chemicals per thousand square feet of flat surface!

JETAL MEETS U. S. ARMY SPECIFICATIONS — 57-O-2C FOR TYPE 3 FINISH. Have your steel samples JETALIZED without cost — or have a JETAL demonstration in your own plant on request.

ALROSE CHEMICAL CO.

PROVIDENCE, RHODE ISLAND WIlliams 1-3000

New York • Chicago • Los Angeles • Portland, Ore.

You can see only a part of the lining story

Rubber lined and rubber covered tank with rubber covered exhaust casing, fabricated and welded by Storts.

PROPER SELECTION of lining material and a good lining job are essential—but the lining cannot stand alone. For long life, it needs a high quality tank under it—expertly fabricated and welded, smoothly finished for good bonding. Storts specializes in high quality lined tanks for all plating room needs.

42 STONE STREET — STORTS WELDING COMPANY INCORPORATED — MERIDEN, CONN.

Manufacturers of Welded Fabrications to Specification

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 272.

CHROMIC ACID

99.75% PURE

MUTUAL CHEMICAL CO. OF AMERICA — SINCE 1845

POTASSIUM BICHROMATE

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SODIUM BICHROMATE

MUTUAL CHEMICAL COMPANY OF AMERICA

270 Madison Avenue, New York 16, N. Y.

Personals

motor-generators. Since his graduation from Case Institute of Technology as an Electrical Engineer, he has spent several years in industrial sales and engineering and 39 months in the U. S. Navy.

William J. Weed, Manager of Sales, and **Louis E. Bauer,** Manager of Production, have been elected Vice-Presidents of Niagara Alkali Company. Mr. Weed has been with the company since 1913 and

Weed **Bauer**

Mr. Bauer since 1917. Mr. Weed has served as a Director of the company since 1941. With his election as Vice-President, Mr. Bauer also has been made a Director of the company.

Wilfred S. McKeon, President of Sulphur Products Company, Inc., Greensburg, Pa., recently resigned the secretaryship of the Westmoreland County Chapter of the National Foundation for Infantile Paralysis, a post which he held since its organization in 1939. "Doctor's orders" was given as the reason.

Joseph Mazia, formerly Chief of Rust Proofing Division of the American Chemical Paint Company, Ambler, Pa., has recently become consulting engineer with

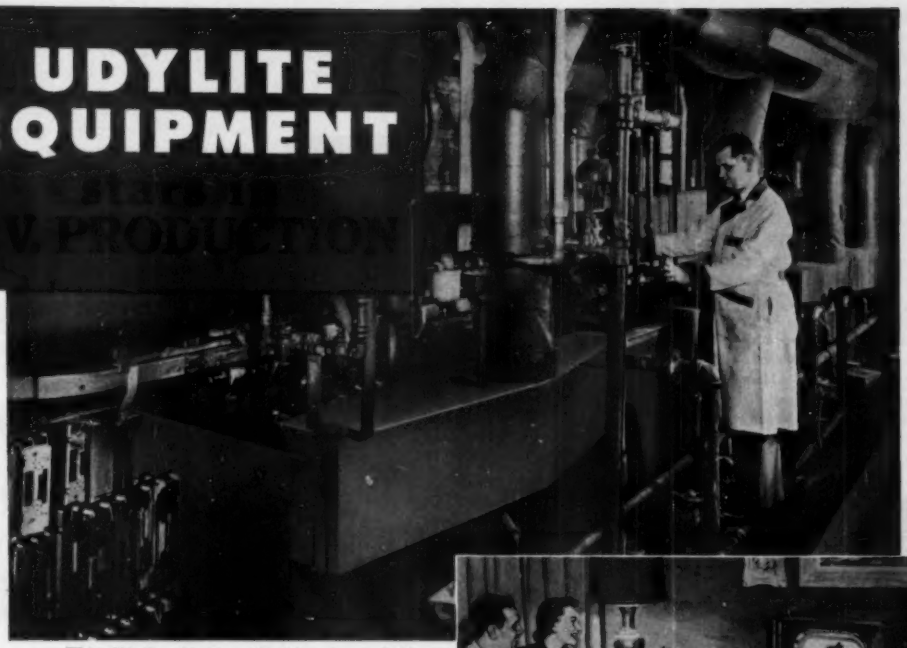
Mazia

offices at 1424 K St., N. W., Washington 5, D. C. At the present time, he is consultant for the American Chemical Paint Company and Stoner-Mudge, Inc.

Earlier Mr. Mazia was the head of the Protective Finishes Section of the Pitman-Dun Laboratory, Frankford Arsenal, and was metallurgist for A. Mazia and Son, Inc., Philadelphia, Pa. A graduate of University of Pennsylvania in 1935, he did postgraduate work in metallurgy and related sciences at the Colorado School of Mines, Temple University, and the Uni-

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 273.

UDYLITE EQUIPMENT



This Udylite Plating Machine is used for applying finish to television receiver components at the plant of Motorola, Inc.

Motorola, Inc., one of the nation's leading manufacturers of television receivers, chose Udylite equipment to speed production and reduce plating costs. Motorola uses a Udylite Full Automatic Plating Machine to apply a protective finish to many small parts—vital to the efficient performance of a television set.

Motorola's engineers are quick to point out the economy and efficiency offered by Udylite automatic plating equipment. Mr. Hank Mirrow, head of the plating department, says: "The Udylite Machine has been a great aid in processing and in conserving manpower in our plant. The machine has given us excellent service and has proved to be a necessity in our manufacturing operations."

You can receive these same benefits for your plant with Udylite methods and machines. Udylite offers a complete range of plating and metal finishing equipment for all plants—all products. Engineers are available for consultation with you—at your convenience—concerning your specific requirements. Call your nearby Udylite Technical Man today and let him give you the complete story of Udylite's facilities and services to better your plating operations. Or write The Udylite Corporation, Detroit 11, Michigan, for full details. There's no obligation.

THE *Udylite* CORPORATION
DETROIT 11, MICHIGAN

PIONEER OF A BETTER WAY IN PLATING

Personals

versity of Pennsylvania graduate school. He is a member of the American Electroplaters' Society, and a registered professional engineer in the Commonwealth of Pennsylvania.

Donald J. Wahler, until recently Chief Engineer, has been appointed General Manager of United Buff Products Corporation, Passaic, N. J. He attended Newark College of Engineering and was formerly associated with Simpro Corporation and Eisemann Corporation.

Victor F. Stine and **Lloyd L. Stouffer** have been elected directors of the Pangborn Corporation, Hagerstown, Md., manufacturers of blast-cleaning and dust-control equipment. Mr. Stine also assumes the duties of Vice-President in charge of sales and engineering and Mr. Stouffer becomes Secretary and Treasurer and takes charge of production. Executive Vice-President **P. J. Potter** is retiring from his more active duties but will continue to serve Pangborn as director and Vice-President.

Stine

Mr. Stine, with Pangborn for thirty-eight years, started as a clerk, progressed through diversified activities, and in 1935 became Vice-President in charge of sales. Mr. Stouffer, with the Corporation for thirty-two years, has served as Secretary and Assistant Treasurer since 1940. Mr. Potter, having thirty-five years' service, started in 1915 as Chicago District sales engineer and for the last twenty-seven years has been located in Hagerstown, first as Works Manager and since 1935 as Director and Vice-President.

Lou H. Moulton, Vice-President and National Sales Director, has retired from Turco Products, Inc. **Dan T. Buist** is the new National Sales Director.

Mr. Moulton joined Turco in 1931 and served successively as Service Engineer, District Sales Manager, Eastern Division Manager, and, from 1947, as National Sales Director. Lately, he bought a Southern California ranch on which he will raise livestock.

Moulton **Buist**

Mr. Buist came to Turco in 1936 after twenty years' experience in the automotive field. He has progressed from Service Engineer to District Sales Manager, Western Zone Sales Manager and Assistant National Sales Director. Mr. Buist has appointed **Stewart B. Van Dyne** as Administrative Assistant, and **Dan T. Miller** as Coordinator of Sales, both newly created positions.

Van Dyne **Miller**

Mr. Van Dyne, who majored in business administration at U. C. L. A., has been with Turco for five years. Mr. Miller spent eighteen years in the industrial sales divisions of two of the nation's largest chemical and paint manufacturers before joining Turco as Jobber Division Manager in 1945.

James Gerity, Jr., President of the Gerity-Michigan Corporation, Adrian, Mich., has been elected a Director of the Doehler-Jarvis Corporation. The Gerity Company is not only a substantial stockholder of Doehler-Jarvis but also an important customer of many years.

You need not worry about Chlorinated Solvent Scarcities!

A FAST... SIMPLE METHOD

The Magnus Emulso-Dip Method of pre-cleaning is speedy, simple and effective. Work is dipped into (or sprayed with) the Magnusol cleaning solution. This solution is made up of Magnusol concentrate and kerosene or safety solvent. It rapidly wets and penetrates the dirt on the work, loosening it so that it is completely flushed off when the work is rinsed with water or steam. Not only oil and grease, but all solid dirts, including metal particles, are removed. In many cases it is not even necessary to heat the solution or the flushing water.

Use the Magnus Emulso-Dip Method of Precleaning for Better Results!

With the Magnus Emulso-Dip Method, using Magnusol or related emulsifiable solvent soaps, you get just as effective a degreasing job and, in addition, far better removal of solid dirts which resist vapor degreasing treatments. The operation is often faster, and, in all cases, much more economical. No worry about corrosion of equipment, attack on metals of units cleaned, or harmful effects on personnel.

Our laboratory will be glad to run tests on any of your pre-cleaning operations to determine what you can expect of the Magnus Emulso-Dip process. You will be welcome to watch these tests if you find it convenient to visit our plant. If you are in need of immediate service, please phone us at Westfield 2-2500 in Garwood.

Write for Bulletin 30 to get the complete Emulso-Dip story.

MAGNUS CHEMICAL CO., 41 South Ave., Garwood, N. J. In Canada—Magnus Chemicals, Ltd., Montreal. *Service representatives in principal cities.*

Magnus

CLEANERS • EQUIPMENT • METHODS

News about UNICHROME Trade Mark COATINGS for METALS

If you can use zinc you can bright-finish

A decorative finish that looks like chromium is easily obtained by processing zinc plate in Unichrome Clear Dip. Since all you need is .0003" of zinc plate, you can make the zinc available to you go further and still provide a good quality, selling finish.

• • •

Your copper tank can be used for "Stopping-Off"

Users of Unichrome Pyrophosphate Copper Plating Process know that it provides fast, dependable stopping off of steel parts in carburizing and nitriding operations. Ask us for details.

• • •

A black dip for zinc that's glossy and uniform

Make use of your plating equipment to get a metallic finish that looks as good as black enamel. This new Unichrome Dip for zinc plate has good gloss; uniformly dense blackness; and increases the rust protection of zinc plate on steel.

• • •

How to save money on painting

Plating plants need extra rugged protection against moisture and chemicals – and get it with Ucilon Protective Coating Systems. Applied to tanks, ducts, walls, piping, tough Ucilon Coatings are helping many concerns maintain equipment in attractive condition, while reducing frequency and expense of painting.

Plating speeded up where it counts most today — in HARD CHROMIUM

Unichrome S.R.H.S. Chromium Bath plates faster, smoother – steps up production without extra equipment

Because of defense orders, you'll see more hard chromium plating being done nowadays than has been for years. And it's being done 20 to 80% faster, too – in Unichrome S.R.H.S. Chromium.

Piston rings, for example, are being plated in S.R.H.S. Chromium by one company in only 3½ hours. It took 5 hours in ordinary chromium. A large plating plant cut plating time on aircraft brake discs from 65 minutes to only 40 minutes by means of S.R.H.S. Chromium. Still another concern is depositing chromium at the fast rate of .0025" per hour on gun turret, engine and other vital aircraft parts.

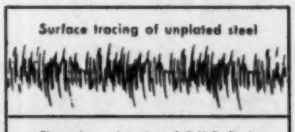
Unichrome S.R.H.S. Chromium not only permits you to plate more tank loads of work per day but often it increases the number of pieces which can be plated *per cycle*. It increases capacity of equipment, reduces load on generators.

SELF REGULATION SAVES TIME AND TROUBLE

Especially valuable for hard chromium is the unique self-regulation of Unichrome S.R.H.S. Chromium. This feature provides peak throwing power with less supervision – assuring good coverage on difficult parts and iron castings.

SMOOTHER PLATE SAVES FINISHING

Because of its superior leveling action, Unichrome S.R.H.S. Chromium smooths over minor surface irregularities in the base metal, as shown by the surface traces below. Therefore, S.R.H.S. Chromium deposits require less grinding and final finishing. For this reason, the amount of chromium you deposit in excess of final requirements can be decreased, resulting in a substantial saving of plating time.



WHAT MASKING TO USE

Stop-off *lacquers* serve you best on large areas that can be sprayed or brushed. Stop-off *compounds* for dipping save time and work on complicated shapes Unichrome Tape can be used on the spot. No matter what the requirement, you'll do an easier, more dependable job with one of the various Unichrome Stop-Offs for all plating conditions.

• • •

Remember, if you are chromium plating now, or expect to do so for defense orders, contact "Headquarters for Coatings for Metals." Let our engineers show you how to meet specifications with speed, economy and minimum rejects.

UNICHROME Trade Mark

UNITED CHROMIUM, INCORPORATED

100 East 42nd St., New York 17, N. Y.
Detroit 20, Mich. • Waterbury 20, Conn.
Chicago 4, Ill. • Los Angeles 13, Calif.
In Canada:
United Chromium Limited, Toronto, Ont.

Trade Literature

L—577. Successful Film Showing—The Motion Picture Bureau of the Aetna Life Affiliated Companies, 151 Farmington Ave., Hartford 15, Conn., offers a 12-page illustrated booklet, "How to Insure a Successful Film Showing", which deals with selecting the room, arrangement of the equipment, and precautions in operation. For your copy, write to the company and mention PLATING.

L—578. Industrial Oven—A new type of industrial oven composed of low-cost electric heater panels and standardized frame members has been announced by Advance Heating Division, Jensen Specialties, Inc., 9331 Freeland, Detroit 28, Mich. It introduces the use of high-efficiency rod-type heaters mounted on insulated oven-wall sections, combining high-speed radiant heating with temperature-controlled convection for industrial heating and drying operations up to 700° F.

Ovens of any size, shape, and heat capacity can be field-assembled from standard parts by electric-maintenance personnel. Rod heaters of any standard brand may be specified. When equipped with approved controls and ventilation, these ovens are said to comply with latest industrial-oven standards.

From 4 to 40 kw may be installed in each 26 x 84-inch panel, shown here extended for servicing. A new folder describing the product in detail is available. For your copy, use Reader Service Card.

L—579. Hand Serrating Tool for Impervious Graphite Pipe—National Carbon Division, Union Carbide and Carbon Corporation, 30 E. 42nd St., New York 17, N. Y., offers a Catalogue Section S-7060 which describes an improved hand-serrating tool for use with "Karbate" Brand Impervious Graphite pipe and method of application. Because Type FC Flexible Couplings are used in fitting impervious-graphite pipe where strong, flexible joints are required, the effectiveness of the joint depends to a considerable extent upon the quality of the serrations on the pipe.

The tool is said to be simple, rugged in design, and extremely easy to use, assuring a tight, workmanlike joint in a minimum of time. Pipe sizes from 1 to 6 inches inclusive, may be serrated. For your copy, use Reader Service Card.

L—580. Alkaline Cleaning of Ferrous Metals—Special Chemicals Department, Pennsalt Chemicals, 1000 Widener Building, Philadelphia 7, Pa., has issued an illustrated service bulletin, "Heavy-Duty Alkaline Cleaning of Ferrous Metals", which describes in detail methods for alkaline soak-tank cleaning, alkaline spray cleaning, and alkaline electrolytic cleaning, barrel cleaning, steam-gun cleaning, and manual (bucket-and-brush) cleaning of walls and floors. Procedures are fully described, including recommendations for proper cleaners. For your copy, use Reader Service Card.

L—581. Phosphate Coatings on Aluminum—Reprints of the Douty-Spruance paper, "Amorphous Phosphate Coatings for Protection of Aluminum Alloys and for Paint Adhesion", are available from American Chemical Paint Company, Ambler, Pa. For your copy, use Reader Service Card.

L—582. Buffing and Polishing Compounds—A new Lasalco catalog of "Buffing & Polishing Compositions" is just off the press. Containing valuable information on buffing and polishing plastics and metals, it is replete with charts showing compositions to use on all types of materials from aluminum to zinc, composition tests, characteristics and grades of compositions, and other useful data. For your copy write on company letterhead to Lasalco, Inc., 2840 La Salle St., St. Louis 4, Mo., and mention PLATING.

L—583. Tank Lining—Metalweld, Inc., 26th and Hunting Park Ave., Philadelphia 29, Pa., offers a 4-page illustrated bulletin describing the application of Koroseal sheet lining to tanks and other metal vessels and its resistance to corrosion by chemicals, including plating solutions. For your copy, use Reader Service Card.

L—584. Cleaning Compounds—Abcoloid metal cleaning compounds for soak tanks, electrocleaners, power washers, bur-

"BUCKY" Says....
for best results you can't beat
BUCKINGHAM
POLISHING AND BUFFING COMPOSITIONS

- Stainless Steel Composition
- White Finish
- Tripoli
- Chrome Coloring Composition
- Greaseless Composition
- Emery Cake
- Brass Coloring
- Emery Paste
- Burring Compound
- Grease Stick
- Spray Pastes—Stainless Steel Tripoli

Representation in Major Cities

Write Dep't B for Samples

The BUCKINGHAM PRODUCTS Co.
14100 FULLERTON AVE. • DETROIT 27, MICH.

Burnishes Better and FASTER

Features

Patented bearing construction assures smooth running — No vibration even with capacity load.

Direct Drive — No belts. Gears fully enclosed.

Motor mounted on top, out of the way — Stays dry — Easily accessible.

Accurately balanced for easy tilting.

Self-sealing cover of light-weight aluminum.

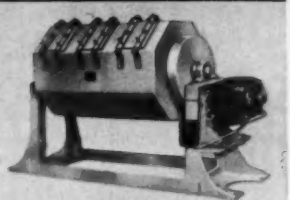
Spring-pressure ratchet lock, released by handy foot lever, holds barrel securely at any angle.

Hard maple lining — easily removable.

Three standard sizes.

DEBURRING BARRELS

3 - compartment barrel can be used for three different deburring jobs at one time. This model is also available with 1, 2 or 4 compartments.



Triple-Action Deburring Barrel for very fast cutting. Specially shaped sides greatly increase tumbling action and reduce deburring time. Ideal for removing heavy burrs and smoothing extremely rough surfaces.

SAWDUST DRYING BARREL

Combination Steam-Heated Sawdust Barrel and Separator. The winning combination for maximum efficiency. Dries the work quickly, leaving it bright and spotless, and separates it from the sawdust without handling.

BELKE *Better-Built* BURNISHING BARRELS

The Modern Low-Cost Method of burnishing stampings, die castings, machined parts and other small pieces. Produces more uniform work with less rejects, and requires less space and labor.

Heavy, welded-steel frame and base affords absolute rigidity. Will not warp or twist when used on rough or uneven floors. There are no protruding feet or braces to interfere with the operator. Patented radial and thrust bearing construction assures that the balls always run in a perfect race regardless of the position of the barrel, providing smooth, long wearing operation.

Write for additional information today or ask to have a BELKE Engineer call and help you select the proper barrel and tumbling compound to do your job most efficiently.

Belke

MANUFACTURING CO.

947 North Cicero Ave. • Chicago 51, Ill.

EVERYTHING FOR PLATING PLANTS

Trade Literature

nishers and barrel cleaners are the subject of an 8-page booklet available from Apothecaries Hall Company, Waterbury 20, Conn. A broad picture of methods and materials for the cleaning of various types of metal parts is presented, and specific recommendations for the application of various cleaning compounds are included. For your copy, use Reader Service Card.

L—585 Certified Lighting Manufacturers—Publication of a new, 4-page RLM Bulletin, No. 1050, containing a complete listing of all RLM Manufacturers and the RLM-certified lighting equipment made by each, is announced by the RLM Standards Institute, 326 W. Madison St., Chicago 6, Ill. Feature is a well-organized, easy-to-use chart, which enables the user to determine quickly (1) whether or not a certain size and type of lighting unit is RLM-Certified, (2) the names of all manufacturers who make RLM-Labeled units of the type and size desired, and (3) those lighting units not yet certified but in the process of being inspected and tested by the Electrical Testing Laboratories.

To facilitate the procurement of additional data, the bulletin also contains an alphabetical listing of all RLM member manufacturers with address. For your copy, use Reader Service Card.

L—586. Water Level Gauges—A 24-page bulletin No. L700 on Water Level Gauges, published by The Bristol Company, Waterbury, Conn., describes instruments for measuring and recording water depth in reservoirs, elevated tanks, rivers, lakes, process and storage tanks, flumes, weirs, etc. Float, pressure-bulb, pressure, counterpoise, differential-pressure, and air-bubbler types are described, including the measurement and automatic control of solutions, whether flowing, turbulent, corrosive, under static pressure, covered with ice, or carrying solid matter. Applications of the instruments to chemical processing operations involving solutions, suspensions, and organic liquids are included.

The bulletin also contains information on remote recording and remote-automatic pump control with Metameter telemetering instruments. A large number of photographs and drawings of typical applications supplement the information. For your copy, use Reader Service Card.

L—587. Air Filter—A high-velocity unit air filter, the American Type HV, has been introduced by the American Air Filter Company, Inc., Louisville 8, Ky. It is made of corrugated strips of fine-mesh wire in which the corrugations taper so that when two strips are placed together they form a series of pyramid-shaped pockets. The small ends of the pockets are closed to the air flow to eliminate open air passages.

These filters are designed to operate at velocities up to 500 fpm and maintain a uniformly high cleaning efficiency over a wide range of air velocities. They can be serviced in the conventional way with washing and charging tanks or reconditioned by washing out the accumulated dust with a hose and spraying with filter adhesive. For your copy of Bulletin 203, use Reader Service Card.

L—588. Water Demineralizers—Penfield Manufacturing Company, Inc., 19 High School Ave., Meriden, Conn., offers a folio containing catalog sheets and other pertinent information on Penfield Ion Exchange systems ranging in capacity from 30 gallons per hour to 1,000 gallons per hour.

Each catalog sheet, in addition to a photographic illustration and working diagram of a particular model, also contains a "Specifications Chart" and a "Performance Chart". With the latter a prospective user may quickly figure the chemical costs of operating that particular model under his own raw-water conditions. Should the solids content not be readily available, the Company will provide a complete analysis at no charge upon receipt of a one-quart sample of the raw water in question. For your copy, use Reader Service Card.

L—589. Centrifugal Pumps—Pumping units for every industry are catalogued in a new 16-page "Handy Guide to Selection of Centrifugal Pumps", issued by Allis-Chalmers Mfg. Company, 922 S. 70th St., Milwaukee 1, Wis. A wide variety of units are indexed. Head-capacity charts and tables for various types are given along with data on sizes, capacities and construction features. For your copy, use Reader Service Card.

From the developers of

IRIDITE®

ARP BRIGHTENERS for ZINC and CADMIUM PLATING

Bright plating troubles go down the drain when you specify ARP Brighteners for zinc or cadmium solutions in barrel, still or automatic equipment! Three trouble-free, efficient formulae, developed in Allied Research laboratories, are available to help you consistently produce a fine grained, clear and sparkling-bright plate:

1. For lowest cost operation of zinc plating without subsequent bright dipping or passivation! Increases solution efficiency to as high as 98% in low current densities. Produces a clear bright plate with a blue chrome-type cast.

2. For zinc plating followed by bright dipping or chromate passivation with Iridite! Lowest cost at high current densities. Yields a plate with a yellow nickel-type cast.

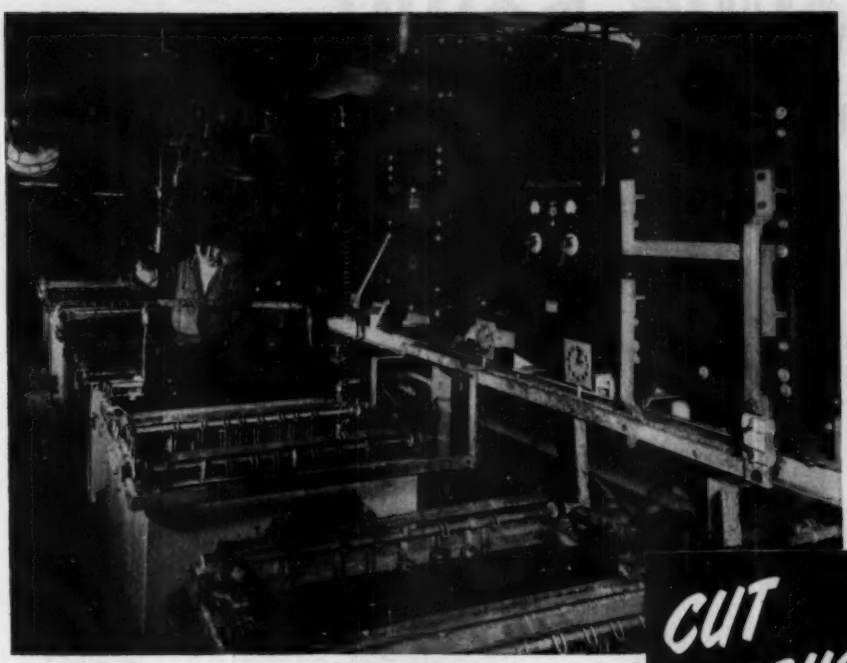
3. For cadmium plating. Produces a silvery bright deposit at any current density.

All three ARP Brighteners offer you many operating advantages including: better throwing power, increased solution efficiency, more efficient metal consumption, uniform coverage, reduced rejects, lower operating costs, higher quality work, ease of use.

INVESTIGATE TODAY! Ask your Iridite representative for full information or write direct. Mention type of plate desired and equipment used in your shop.

Manufacturers of Iridite finishes for corrosion resistance and paint systems on non-ferrous metals; ARP plating chemicals

ALLIED RESEARCH PRODUCTS
INCORPORATED
4004-06 E. MONUMENT STREET • BALTIMORE 5, MD.



THIS G-E PLATING RECTIFIER INSTALLATION

CUT PRODUCTION TIME 66%

The National Screw & Manufacturing Company of Cleveland, Ohio had outgrown their original facilities. Their old system was inflexible and inadequate. Voltage fluctuated as individual tanks came on and off. Uneven plating power was causing uneven plating. Rejections were high and the situation had become critical, especially in view of the company's policy of producing only the highest quality jobs.

To correct this situation the Company decided to completely modernize their plating department and purchased General Electric "Packaged-Power" units—with *copper-oxide rectifiers.*

After the new rectifier system had been installed, here is what they found:

- **Production time cut by an average of 66%**
- **Steady plating voltage—to every tank**
- **Predetermined plating time**
- **Better production scheduling and accurate cost accounting**
- **Better control of quality—rejections practically eliminated.**

All in all, the company has calculated that *the complete investment will pay for itself in less than two years* and then return a handsome annual profit.

What would G-E "Packaged-Power" plating equipment do for you? Your local G-E Apparatus Department representative can show you. ***Apparatus Dept., General Electric Company, Schenectady 5, N. Y.***

GENERAL ELECTRIC

464-3

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 280.

NO SHUT DOWN

To Carbon Treat Solution with SPARKLER FILTERS

A battery of 18 Sparkler Filters in one of the largest bright nickel plating plants in the world.

Carbon treatment without shut down is accomplished by cutting out one or two units in a battery of filters, removing the cartridge assembly of filter plates, and replacing with a new plate cartridge dressed with clean filter paper. The proper amount of carbon is mixed with water in a standby tank and recirculated through the filter thus depositing the carbon on the new plates in a cake of uniform thickness and density. The solution requiring a carbon treatment is then circulated through the carbon beds giving the plating solution the carbon treatment without contaminating the tank or stopping plating operations.

The quick change feature of the plate cartridge in Sparkler filters permits replacing a set of plates in a matter of minutes. Production can be resumed without appreciable interruption.

Sparkler Horizontal Plate Filters give absolutely sharp filtration at all stages of the cycle.

SPARKLER FILTERS

SPARKLER MANUFACTURING CO.
Mundelein, Illinois

Equipment and Supplies

E—649. Pneumatic Acid Pump—A pneumatic bulb-type acid pump is obtainable from the Hanson-Van Winkle-Munning Company, Matawan, N. J. The primary feature is the reduction in fumes. With this pump, it is possible to fill bottles with small neck openings without the use of a funnel. The stream of acid is smooth and much faster than the stream from a siphon.

The pump is easily transferred from one container to another. The overflow pipe has no connection with the valve body, and when the pump is withdrawn, no acid remains in it. It also serves as a gauge, showing the amount of acid left in the carboy. Seran plastic tubes are featured. Also available are tubes of lead, hard rubber, or aluminum. For further information, use Reader Service Card.

E—650. Synthetic Enamel Resembling Chromium—Parts which are normally chromium plated can now be coated with a special synthetic enamel that produces a finish very closely resembling chromium, according to Maas & Waldstein Company, Newark 4, N. J. The new finish—latest member in the M & W line of Britelume coatings—is applied over zinc or steel by spraying, and may be air-dried or baked.

Many industries are said to have tested and approved Britelume as a substitute for chromium on automobile parts, hardware, lamps, metal furniture and bathroom fixtures. For further information, use Reader Service Card.

E—651. Conductive and Nonconductive Plastics—Atlas Mineral Products Company, 42 Walnut St., Mertztown, Pa., has developed resin cement called Conductoplast, which may be cast in almost any form and exhibits practically no voltage drop when used as a conductor. It can be readily plated, has a tensile strength 1500 psi, a compression strength of 15,000 psi, and excellent adhesion to ceramic materials.

A nonconductor called Resistoplast has much the same properties as Conductoplast except that it does not conduct current. Both materials are available in

Cowles

SM CLEANER

a non-foaming cleaner

for 1 . . . use as an electrocleaner (cathodically, anodically) on steel when exceptionally high current densities, tank design or type of work tend to produce excessive foaming.

2 . . . use as a detergent in all types of washing machines for die castings, steel, brass and copper.

Because it is formulated with water conditioners, Cowles SM Cleaner is especially effective under hard water conditions.

prompt shipments from convenient warehouse stocks

COWLES TECHNICAL SERVICE
gladly furnished upon request

COWLES CHEMICAL COMPANY
METAL CLEANER DEPARTMENT
7016 EUCLID AVENUE • CLEVELAND 3, OHIO

Looking for a Better Finish?
Try
HARRISON'S

4A

TAILOR-MADE
BUFFING AND POLISHING COMPOUNDS
for
Aluminum, Brass, Copper, Stainless Steel, Carbon Steel, etc.

EMERY CAKE, GREASE STICK

CEMENT AND THINNER
for setting up wheels, belts and rolls

HARRISON & COMPANY, Inc.
HAVERHILL, MASSACHUSETTS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 283.

SPECIALISTS IN *CHEMICAL-PROOF* CONSTRUCTION

Heil CLEVELAND

FOR HEATING or COOLING CORROSIVE LIQUIDS

USE *NOCORDAL
*Trade Name
IMPERVIOUS GRAPHITE

"U" COIL

GRID EXCHANGER

• *EXCELLENT HEAT TRANSFER*
• *RESISTS MOST CHEMICALS*
SHELL AND TUBE EXCHANGERS • ELECTRIC UNITS •
• IMMERSION COILS •
FOR REAL COST SAVINGS . . .
"INVESTIGATE HEIL'S COMPLETE LINE OF STANDARD UNITS"

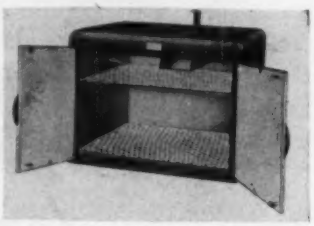
Heil PROCESS EQUIPMENT CORP.
12901 ELMWOOD AVE • CLEVELAND 11, OHIO

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 284.

Equipment and Supplies

pilot-plant quantities, and production facilities can be expanded for critical end use. For further information, use Reader Service Card.

E—652. Portable Electric Oven—The application of production line methods has enabled Grieve-Hendry Company, Inc., 1101 N. Paulina St., Chicago 22, Ill., to produce a portable industrial electric oven at an exceptionally low price. Field tested, it is said to have been found practicable for baking of enamels, lacquers, wrinkles, and other finishes.



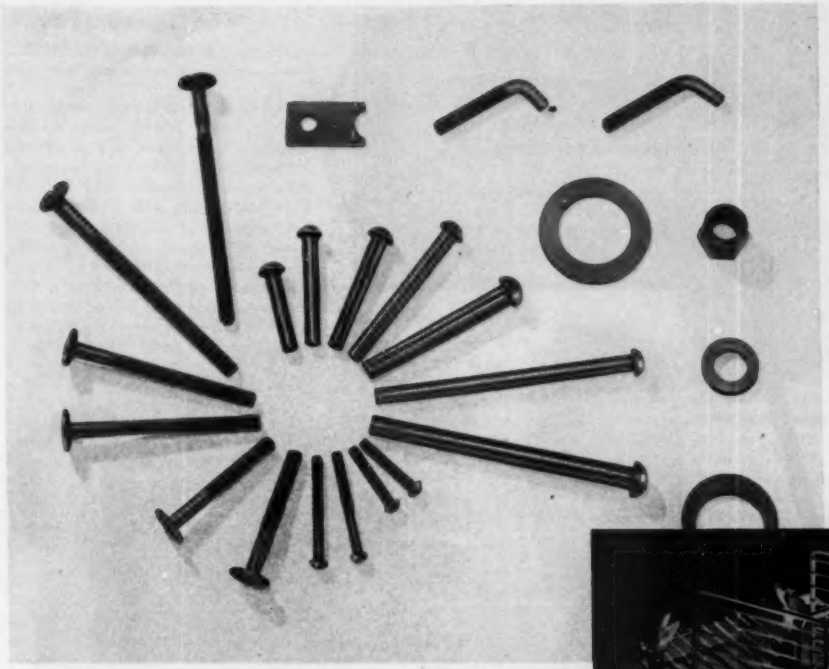
Features include uniform temperature throughout. Fresh air is drawn in and stale air driven out through specially located vents by means of a fan driven by a motor mounted on the outside of the unit. It is claimed that no stratification is possible. Adjustable damper gives wide range of constant temperature.

The ovens are so constructed that one will nest on top of the other. They can be used in groups or as individual ovens, or selected ovens in the group can be cut-out or heated at different temperatures. Size is 29 x 24 x 20½ inches high. For further information, use Reader Service Card.

E—653. Calculator for Statistical Analysis—Statisticians in industrial quality control and engineering research will welcome a new desk calculating instrument, the Merrill RMS Slide-Disk, sold by Graphic Calculator Company, 633 Plymouth Court, Chicago 5, Ill., which simplifies the computation of standard deviations, root-mean-squares, correlation coefficients, regression lines, etc. By a unique principle of graphic calculation, statistical results are obtained in a fraction of the time previously required and to an accuracy of 0.5 per cent or better. For further information, use Reader Service Card.

E—654. Dust Collector—A new, self-contained Dustkop dust collector, with 9 cu ft dust-storage capacity has been added to its line of unit dust collectors by Aget-Detroit Company, 111 Main St., Ann Arbor, Mich.

Known as the Model 20B30, the new



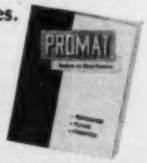
STABILIZED ZINC
is the answer to
1951 PLATING PROBLEMS

Zinc, *when stabilized to prevent white corrosion,* is ideal for protecting and/or beautifying all types of products from fastening devices to light fixtures.

Low cost Promat secondary treatments for zinc electro-deposits, hot dip galvanize and zinc base die castings protect the zinc against corrosion and make it paintable as well. Bright, semi-bright, dull and olive drab type finishes are available. The procedure involves only small quantities of addition agents in the plating bath and a simple secondary dip. The result is a highly protective finish which will stand up as well, or better than, many other types of finishes even under adverse conditions. Promat bright zinc, unlike bright-out-of-the bath plating, stays bright . . . and it costs less.

It will pay you to find out more about Promat secondary protective treatments, addition agents and zinc electrolytes.

SEND FOR THIS FOLDER
describing Promat products for better zinc plating.



PROMAT DIVISION
Poor & Company
851 S. Market Street, Waukegan, Ill.

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HAVILAND PRODUCTS CO.
Grand Rapids, Michigan

WAGNER BROTHERS, INC.
Detroit, Michigan

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Milwaukee, Wisconsin

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BART-MESSING CORP.
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Philadelphia, Pa.

ARDCO, INC.
Chicago, Illinois

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 295.

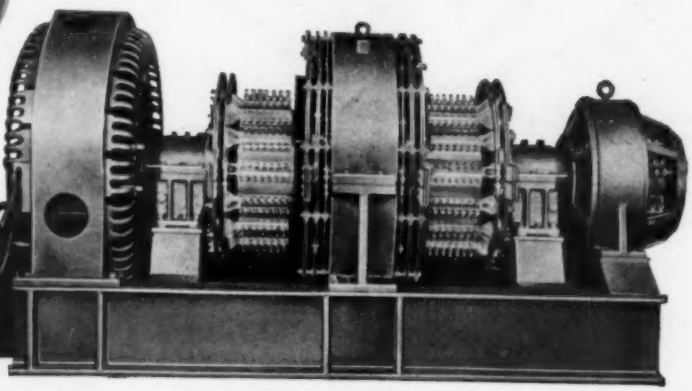
PLATEMANSHIP

H-VW-M's unique combination of:

. . . the most modern and complete laboratory for testing and development

. . . ability to provide complete equipment and materials for every plating and polishing need

. . . the complete background of knowledge and experience in every aspect of plating and polishing.



Only H-VW-M PLATEMANSHIP

brings you so many advantages in low-voltage generators

. . . Brush holders are one piece bronze castings, completely insulated from the electrical circuit; and supported from the bearing pedestal for easy inspection of brushes and commutator

. . . Special copper graphite brushes insure long life and high conductivity

. . . Moulded-in "Equaload" shunts reduce resistance, eliminate selective action, equalize current distribution

. . . Commutator and field coils are properly ventilated by fan action of commutator risers

. . . Rolled steel ring in frame reduces vibration

. . . Long, trouble-free life is assured by oversize sleeve-type bearings

These are the reasons why H-VW-M low-voltage Generators are widely used for electroplating, anodizing, electrotyping, producing electrolytic chemicals and metal refining. They are available in a complete range from 200 to 25,000 amperes and in standard voltage ratings of from 6 through 60. For special applications H-VW-M can design and build motor generator sets to meet any low-voltage requirement and condition.

Each H-VW-M Generator embodies all the refinements developed through three-quarters of a century of building generators for the plating and polishing industry. They fully reflect H-VW-M *Platemanship*—the ability to meet and even anticipate every need of industry in every phase of pickling, polishing, buffing, cleaning, anodizing and plating.

For full details ask for Bulletin G-102.

HANSON-VAN WINKLE-MUNNING COMPANY, MATAWAN, NEW JERSEY

PLANTS AT: MATAWAN, N. J. • ANDERSON, INDIANA • SALES OFFICES: ANDERSON • CHICAGO • CLEVELAND DAYTON • DETROIT • GRAND RAPIDS • MATAWAN • MILWAUKEE • NEW HAVEN • NEW YORK PHILADELPHIA • PITTSBURGH • ROCHESTER • SPRINGFIELD (MASS.) • STRATFORD (CONN.) • UTICA

H·VW·M

7620

INDUSTRY'S WORKSHOP FOR THE FINEST IN PLATING AND POLISHING PROCESSES • EQUIPMENT • SUPPLIES

unit uses the basic elements of the standard, pretested Model 2030 Dustkop, namely, a 3-hp continuous-duty motor direct-driving a paddle-wheel self-clearing fan, a cyclone separator, and a second-stage fibre-glass filter with shaker which permits the cleaned air to be recirculated within the working space. The caster-equipped roll-away bin is so arranged that it receives the bulk of the collected dust directly from the bottom of the cyclone separator. A quick-acting connection at the lid of the bin allows easy detachment of the bin for emptying.

Suction capacity is 2,405 cfm on a 7-inch inlet pipe, according to instrument test. The unit is recommended for collecting the dust from 6 grinding wheels of up to 16-inch diameter or 3 buffing or polishing wheels of up to 24-inch diameter. For further information, use Reader Service Card.

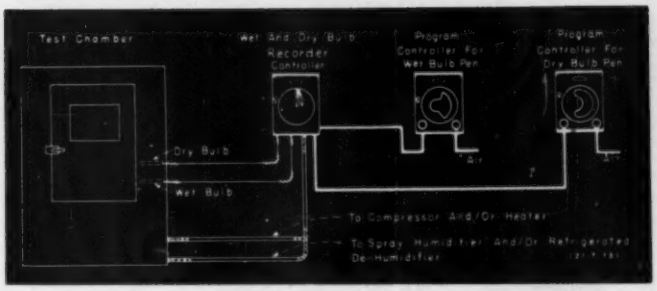
E—655. Coatings for Zinc and Steel Simulate Copper, Brass, Bronze—Maas & Waldstein Company, Newark, 4, N. J., offers Platelustre, new finishes closely simulating the appearance of copper, brass and bronze. They are said to have withstood satisfactorily 800 hour salt spray and weatherometer tests, and to be available for both air-drying and baking schedules.

Platelustre is expected to be of particular interest to makers of lipstick shells, compacts, builders' hardware, lamps, and similar items, in which the public has come to expect the appearance of copper, brass and bronze. For further information, use Reader Service Card.

E—656. Washable Marking Crayon—"Crayoffs", available from the Celco Corporation, 1631 Tenth St., Santa Monica, Calif., are made with a patented soap base so that crayon marks can be wiped off with a damp cloth without marring the appearance or surface of the material. They are 4½-inches long, ½-inch in diameter, and can be had in eight colors for use on metal, glass, or wood. For further information, use Reader Service Card.

E—657. Control Arrangements for Humidity Tests—Stringent tests required of Government purchased apparatus and materials has crystallized the need for accurately controlled test chambers such as manufactured by Tenney Engineering, Inc., 26 Avenue B, Newark, N. J.

Maintenance of desired temperature and humidity is accomplished through the operation of a control system to the left of the figure. The wet- and dry-bulb controller provides two distinct control actions: (1) Deviations from the set point by the dry-bulb pen produce an on-off control action which interrupts the coolant or heat transmitted into the test chamber so as to maintain the internal temperature. (2) Deviations from the set point by the wet-bulb pen produce a similar action which results in spray humidification or refrigerated dehumidification to maintain the humidity.


Test Chamber
Wet And Dry Bulb Recorder Controller
Program Controller For Wet Bulb Pen
Program Controller For Dry Bulb Pen
Dry Bulb
Wet Bulb
To Compressor And/Or Heater
To Spray Humidifier And/Or Refrigerated De-Humidifier

Controlled change of conditions is produced by the action of a program controllers added at the right. Each controller through a time-pattern cam cut to form the desired program automatically positions the set-point index of the primary controller so as to produce the desired rate of change on the controlled variable. For further information, use Reader Service Card.

HOLD IT!
Are you troubled with finishing problems on defense orders?
HOLD IT . . .
PHONE SIEFEN!
NUGLU and BRUSHING NUGLU are exceeding today's specifications as they have in past crises.
SWIMMING AT YOUR OWN RISK!
J. J. Siefen CO.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 287.

BETTER THAN EVER

The True Insulator will give you more safety than before with the same standard of insulation as always. Wire braid hose on the ¾" and 1" sizes insures absolute freedom from failure. The ½" size has been completely redesigned to give higher quality with longer life. With all these improvements the True Insulator is a better bargain than ever.

THE TRUE INSULATOR

is specifically manufactured to insulate your plating operations from grounds and short circuits through the heating coils, cooling coils, air agitation systems or other pipe connections. The True Insulator provides more positive insulation than any other type known.

Available in following sizes

½ inch.....$7.00 per pair
¾ inch.....$7.50 per pair
1 inch.....$8.50 per pair

Quality Discounts

TRUE BRITE CHEMICAL PRODUCTS

P. O. Box 31, Oakville, Conn.

PRACTICAL PRODUCTS FOR PRACTICAL PEOPLE

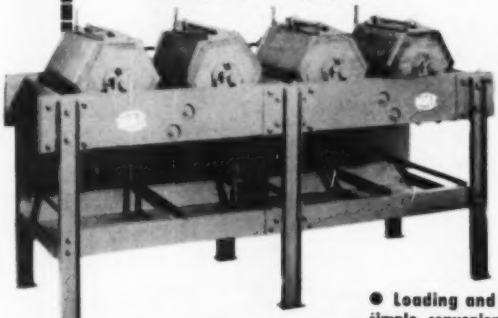
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 288.

DANIELS

FASTER FINISHING

For Stamping Screw Machine Parts and Small Castings

All these and wide varieties of other metal parts can easily and rapidly be finished in this DANIELS Multiple Tumbling Barrel.



- Single motor drive
- Each compartment individually controlled
- Loading and unloading is simple, convenient and easy
- Water and waste is easily disposed of
- Compact, versatile and economical

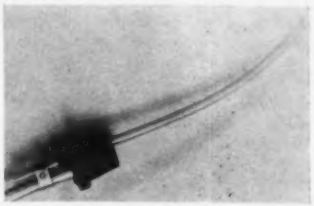
DANIELS PLATING BARREL & SUPPLY CO.

MANUFACTURERS and DISTRIBUTORS

Electroplating and Polishing Equipment and Supplies
129 Oliver Street, Newark 5, N. J. • Tel. MArket 3-7450

Write for complete details today

E—658. Carboy Pouring Spout—Hanson-Van Winkle-Munning Company, Matawan, N. J., supplies a safety air-vent carboy pouring spout, which insures an even flow of acid without spurts or



splashes. It is made of ac'd-resistan rubber and plastic tubing. All parts are replaceable, and one size spout fits all carboys. For further information, use Reader Service Card.

E—659. Barrel Finishing Compounds—Almco Supersheen, Albert Lea, Minn., has announced three new compounds.

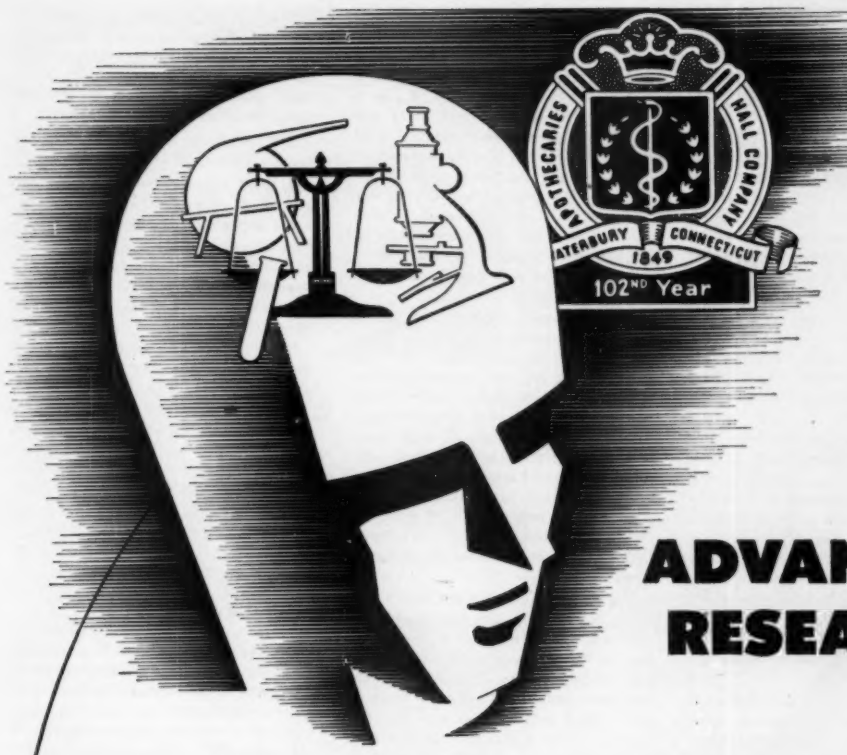
Almco Supersheen Abrasive Compound No. 3 contains a very aggressive abrasive and can be used with water. A replacement for the old "emery-and-oil" method of tumbling it provides substantial savings. Advantages are: fast cutting, free rinsing, oxidation inhibition, improved color, rust prevention, and unusually low processing costs. It is recommended for use in self-tumbling and tumbling with abrasive chips.

Almco Supersheen Coloring and Burnishing Compound No. 10 is especially designed to produce highly burnished finishes. It prevents discoloration of work due to compound breakdown and produces a clean, free-rinsing surface with no fatty soap deposits which might interfere with subsequent electroplating. Aluminum and stainless steel colors are protected during deburring and grinding cycles.

Almco Supersheen Descaling Compound No. 15 is slightly acid and has been designed especially for applications requiring quick descaling of steel parts. It descales, deburrs, and polishes simultaneously when used in combination with abrasive chips. Under actual operating conditions, it has been possible to replace an acid pickling operation, a sand blasting operation and quite often a grinding, burnishing or coloring operation with treatment with this new compound. For further information, use Reader Service Card.

E—660. Corrosion-resistant Coating—The Atlas Mineral Products Company, Mertztown, Pa., announces Atlastic 58, a hot-melt corrosion-resistant plastic product, which is said to have outstanding adhesion to concrete and steel and to be resistant to a large number of acids, alkalies and salts. For further information, use Reader Service Card.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A 289.



ADVANCED RESEARCH

for new materials, new methods . . . even better AHCO finishing products

New and improved metal products mean constantly changing requirements for cleaning, buffing and plating. Leadership in the manufacture of cleaners, buffing compounds, and nickel anodes is determined by the ability to stay ahead of immediate demand through advanced chemical research. Today Apothecaries Hall Company chemists, working far beyond the range of present needs, are developing the new finishing materials and methods that will make your metal products look better and sell better . . . tomorrow, next week, and next year.

Have you taken advantage of AHCO's free engineering and analytical services? Let our trained representatives help you set up that new finishing room; let our chemists analyze the finishing chemicals you are now using . there is no obligation.

For better finishing products, equipment, and know-how write today to Apothecaries Hall Company, Waterbury 88, Conn.

Over a Century of Service

APOTHECARIES HALL CO.

WATERBURY 88 CONN.

The Mailbox

Subject: Gold Plate

DEAR SIR:

The late Mayor of New York, F. H. LaGuardia, once admitted with admirable frankness: "I don't make a mistake very often, but when I do it's a beaut". Something similar can be said about the Federal Trade Commission in connection with the rules it has promulgated for the marking of items coated with gold or its alloys. This "beaut" has definitely restricted employment opportunities for platers in the field of gold deposition and has undoubtedly retarded technological advances in gold plating, as so ably pointed out by Dr. Weisberg.

We of the American Electroplaters' Society, in an indirect way, are to a large extent responsible for this error on the Commission's part, because we failed to supply guidance at the time our interests were under consideration. However, it is not yet too late to rectify this error if we present officially our case to the Commission. Rules already in force can be declared null and void, and more equitable regulations can be put on the Federal Trace Commission's books, if we put up a battle for them.

Lest some eyebrows be raised, it should be remembered that even such an august body as the Congress of the United States is capable of error, and it is not unknown to have a high-sounding law or even a constitutional amendment repealed, because it turned out to be a boner. Remember prohibition?

What is needed at once is a complete, clear, unequivocal and fair set of rules in connection with the marking of gold-coated articles that will take into account, equitably, all competing methods of coating a base metal with a precious one. At the present time we do not have such rules.

Let us consider the matter from the start and be honest enough to call a spade a spade and not pull any punches, even if it hurts a little here and there.

The avowed purpose of a Commercial Standard is to protect the consumer from fraud and deception, particularly in connection with "blind" items. This, of course, sounds nice and makes for high-sounding phraseology; but truth be told, manufacturers no matter in what field, who desire to set "standards" in their industry, usually do so to protect, not the public but themselves. If there is any protection of the public in these "standards" it is, unfortunately, incidental to the protection given the manufacturer from his competitor. Anyone who believes that a trade organization sets up "standards" from benign consideration of the consumer is, to understate it slightly, naive. When a public-minded group attempts to devise a set of standards with the consumer genuinely in mind, most of the manufacturers involved will fight it tooth and nail. A case in point is the complete rejection by most members of the Canner's Institute (trade organization of the canning industry) of the quality-marking standards for canned-goods labels proposed by the National Consumers & Retailers Council. Today, you will find the quality marking proposed by the Consumers Council in possibly one out of ten brands of canned peaches, for example.

This apparently selfish attitude on the part of the manufacturer, while certainly not to be condoned, cannot be condemned. For example, the manufacturer of a piece of gold-plated jewelry would raise a mighty squawk if he had to mark on his product "contains 2 cents worth of gold", and the manufacturer of gold-filled items would howl to the heavens if he were obliged to mark his product "contains 50 cents worth of gold" or "edges not coated with gold". It is better that we consumers do not know everything!

The manufacturer does not have to tell all on his label to give the consumer a square deal. He knows that his reputation, or "brand name", will stand or fall (and his business concomitantly) with the long-time quality of his product—regardless of what ballyhoo goes into advertising it. The legitimate manufacturer strives to make his product talk for him. He must, however, protect himself from unfair competition by less worthy gentry, and that is the basic reason why commercial "standards" are set.

Consider for example the following "consumer-protective" marking that might possibly be found under the present rules on a watch band: "1-20 12k gold filled" or its abbreviated form, "1-20 12k GF".

I challenge the Federal Trade Commission to stop ten laymen on the street in any average town (Attleboro and Providence excepted and even of that I am not sure) and get from even one of them the correct meaning of these hieroglyphics. As a matter of fact, these symbols tend to be misleading, because to the average layman the marks "1-20" and "filled" have little significance but 12k has. In the layman's mind it is associated with solid gold. It is thought of as a "hall mark", which in the old days was a stamp on a solid gold item giving its purity and the name or symbol of the maker. This association with solid gold alloys is there, and whether by design or not the rolled-gold manufacturer gains by it.

An article that is made of a base metal and coated with gold or gold alloys is essentially not a "blind" item. It can be examined for size, workmanship, and beauty of design. The only thing the consumer does not know is its actual composition. That is the only thing that can be logically stamped or marked on the item; all else should appear in the advertising literature of the manufacturer.

Accordingly, an equitable marking system should be based on the following:

1. Only homogeneous solid gold-alloy articles can be stamped with a karat symbol to indicate gold content, such as 14K.

2. Jewelry articles of all other metals coated with a layer of gold or gold alloy, regardless of its composition and method of application must be stamped only with the percentage of gold.

Thus for example, what is commonly marked "1-20 12k gold filled" or "1-20 12k GF" would appear as "2.5% FG" or "2.5% filled gold". What is marked "1-40 14k rolled gold" would appear as "1.7% RG". A heavily gold-plated item might appear as "0.2% EG", standing for "0.2% electro gold".

If the word plate is to be used on the item then it should be freely usable to all as:

Rolled gold plate (RGP)
Filled gold plate (FGP)
Electro gold plate (EGP)

Flash, color or dip gold deposits are still electroplates and must be considered as such, and a manufacturer of cheap items who wishes to mark his work EGP must actually place the percentage composition of gold by weight alongside of the letters EGP. If the amount of gold is so small as to be insignificant, the marking would be, for an example, 0.001 % EGP, meaning that it contains less than 0.001 per cent of pure gold. Similarly, the percentage composition must be given in any advertising matter if the manufacturer wishes to state that an item carries an electro gold plate.

This is the only fair way to mark items that are not solid gold. A manufacturer who has a process that electrodeposits a layer of gold equivalent in thickness, weight, or wearing qualities to layers produced by competing methods can meet competition on an equal basis and is not stymied by obsolete and unfair marking methods that have been given the force of law by pressure on the Federal Trade Commission. Incidentally, if the left hand will let the right hand know what it is doing, the Department of Internal Revenue can get together with the Federal Trade Commission and decide on a definite percentage composition above which an item becomes excise taxable as jewelry. This seems far more practical than going by minimum thicknesses which cannot be measured with any accuracy to speak of, except with great difficulty, whereas the weighing of one or more pieces to determine the average percentage of gold plated is entirely feasible.

Sincerely,
JOSEPH B. KUSHNER

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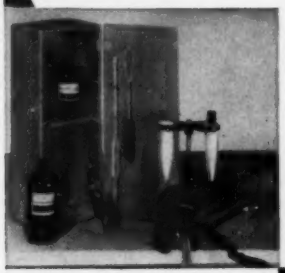

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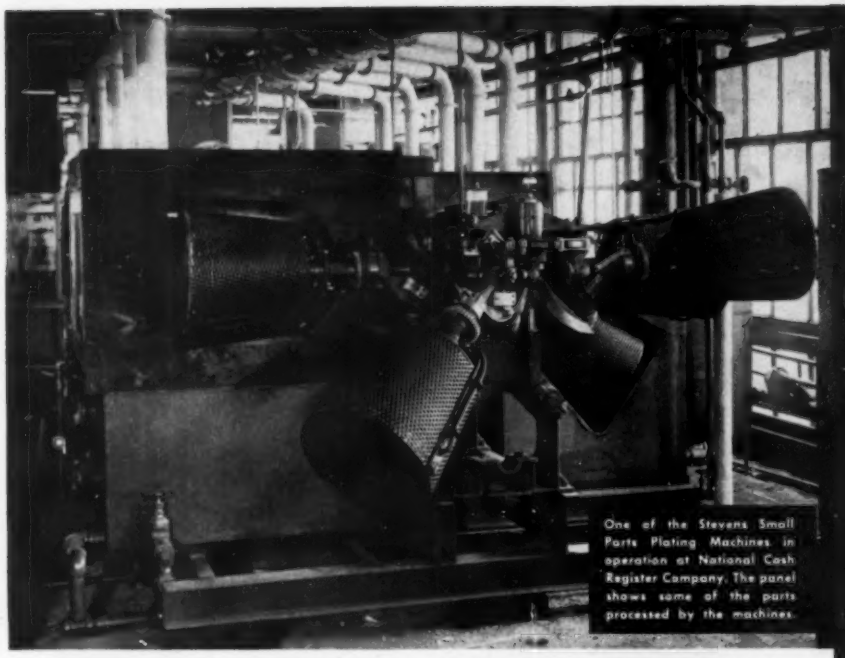

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Editorial

Fact or Fancy

WITH THIS ISSUE, PLATING passes a milestone in its existence. You may not have guessed it, but we refer to the publication of the A. E. S. Research article by Linford and Saubestre.

To our knowledge it is the first time that the authors of an article on these pages have applied the *t* test and the *L* test to experimental data and thereby shown how good the data is.

One of the disturbing things about the technical literature is that so many of the conclusions drawn are not backed up by facts. As a result, when they are put to practical test in the shop, they do not always turn out to be correct. In many cases, this could have been discovered if the simple tests referred to had been applied before the article was written.

It is to be hoped that more investigators will learn to appreciate and use these tests. When that is done, the practical man will have reason for more confidence in what he reads, and will have more fact and less fancy with which to work.

Gustaf Soderberg

PLATING WASTES . . .

*Treatment and Disposal**

J. E. COOPER†
DuBois Cooper Associates, Detroit, Mich.

One of the most striking and long remembered examples of stream pollution is the catastrophic effect on the biological population of a stream during a fish killing resulting from an excessive concentration of cyanide. Such happenings are not uncommon newspaper items throughout the country. Many states are now assessing substantial fines against those responsible; new and more stringent laws and regulations are being drafted to regulate closely the safe handling and disposal of spent cyanide and plating solutions.

Concern has been expressed by a minority in the electroplating industry that such actions are singling them out—"picking on them". However, in the great majority of cases, the electroplating industry has moved rapidly to "put its house in order" and to correct potentially hazardous conditions before any such industry-wide controls are established.

The efforts of the American Electroplaters' Society in establishing research on technical methods which electroplaters may use to assist them in correctly handling their problems are especially meritorious. The complete bibliography and thorough critical review of the literature stand today as the most informative source on the general subject of plating-waste disposal[1,2]. The associated activities and the methods used by A. E. S. to inform its membership on plating-waste problems are extremely interesting.

Sources of Plating Wastes

There are two general sources of wastes from plating operations, each of which is distinctive as to volume and chemical characteristics:

1. Batch solutions
2. Rinse waters, including both non-overflowing reclaim rinses and continuous-overflow rinses

Design or consideration of any waste-treatment facility or process requires a categorical separation of all solutions in a plant into one or the other classification, as the treatment of each type is usually different.

Concentrations of batch solutions are generally reported in terms of ounces per gallon. However, in water and sewage terminology, a typical copper cyanide bath might contain 500,000 ppm of copper cyanide. Although authorities are not agreed on the exact toxicity to fish of the cyanide ion, 0.1 ppm is a generally accepted value in natural water. In view of this, there is little wonder that cyanide plating baths are the most hazardous solutions used in industry.

Disposal Methods

The methods used for disposal of waste from plating operations might be divided into the two following general classes in order of importance:

1. Modifications in design or operation or both within the manufacturing process to minimize or eliminate the waste problem.
2. Installation of a chemical treatment to destroy toxic and objectionable wastes in plating-room effluent.

It is strongly believed that much can be accomplished to eliminate the potential threat of stream pollution by adequate initial plating-room design. Obviously, such design should be directed toward the concentrated baths, or physical changes within existing plants. This is apparent when it is considered that the 70 or so fish killings due to cyanide in Michigan following World War II all resulted from the accidental or intentional discard of concentrated baths and not from rinse waters! Under such circumstances, plants designed primarily to handle rinse waters might be inadequate if suddenly required to handle such strong wastes.

Suggested Modifications in Plating Room Design

Before any chemical treatment plant is designed or installed, every effort should be made to minimize the danger in continuously handling hazardous plating solutions by adequate engineering design within the plating room. For example, in the oil industry, where large volumes of inflammable liquids are stored, regulations require adequate dikes to confine the contents of oil and gasoline tanks in case of a failure

By analogy, it should become established practice for those tanks in a plating room which contain toxic metals and their salts, as well as acids, alkalis, etc., to be served by gravity-fed, non-overflowing,

*Presented at 23rd Annual Meeting of the Federation of Sewage and Industrial Wastes Associations, Washington, D. C., October 9–12, 1950. Reprinted with permission Sewage and Industrial Wastes, March, 1951.

†Formerly Supervisor, Special and Sanitary Engineering Section, Office of Plant Engineering, Ford Motor Company, Detroit, Mich.

emergency holding tanks[3]. A continuous curb of sufficient height should surround the area around each tank containing solutions whose loss would result in stream pollution. Any spillage, drag-out to the floor, leaks, or other losses would then be directed to flow by gravity from inside the curbed area to the holding tank. Obviously, in each plating plant there would be a minimum of two such tanks—one for acidic wastes, including chromium; one for alkaline wastes, including cyanides. With such a layout, rinse waters are piped directly from the individual rinse tanks to the proper waste sewer.

The arrangement described above is not only good pollution abatement insurance but also, in many cases, an economic benefit, as the collection of the contents of just one large metal-plating bath, accidentally lost, would go far in paying for the holding tanks. (For example, the loss and subsequent recovery of a 10,000-gal nickel bath might result in recovery of as much as $10,000 worth of plating solution.)

As a general principle, reclaim rinse tanks should follow all metal-plating baths. In some cases, two such tanks should be installed, one immediately following the other, in order that the subsequent continuously overflowing rinse water be of low enough cyanide concentration for discard directly to a stream or sewer system without further concern.

Reclaim tanks are very successful where the preceding plating tank is operated at a relatively high temperature. In such cases, the evaporation loss in the plating tank is high, and the contents of the reclaim tanks can be readily returned to the plating bath. The fresh water then added to the reclaim tank keeps its concentration of plating chemicals at a low value.

When one deals with lower-temperature operations, however, the concentration of plating compounds increases in the reclaim tank faster than the evaporation loss of liquid from the plating tank. The concentration in the reclaim tank soon approaches the concentration of metal salts in the plating tank. As this occurs, the concentration of wastes in the following overflow rinse increases. Obviously, the contents of the reclaim tank will then have to be disposed of to the treatment plant and the tank refilled with fresh water.

At the Chevrolet plant in Flint, Mich., an interesting evaporation system has been installed in the plating department to handle such problems. Water is simply boiled off the reclaim solution, and the low-volume concentrate is then readily returned to the plating bath.

Another frequent source of stream pollution from plating rooms is the filter area. Often the pumps, hoses, or other mechanical equipment used in the transfer or purification of solutions suddenly fail or are carelessly left in such a manner as to siphon out the tank contents to the floor or sewer. As in the case of plating tanks, filter areas should be served by a separate curbed mat draining to a holding tank.

Ventilation systems in plating plants equipped with wet washers to remove fumes from exhausted air often contain high concentrations of chromium, as well as other plating-bath constituents. Solutions from such systems should be recirculated to reduce their volume and occasionally discarded to a disposal plant for further treatment.

Sludges, spent filter cake, etc., should be sent to the waste disposal plant to be "detoxified". Glass containers should be eliminated from plating rooms as a safety precaution[3].

Heat exchangers immersed in plating tanks should be so designed that any leak in an exchanger will not allow cyanide to escape to the sewer system with the cooling water. Likewise, the design should preclude the possibility of leakage of cooling water into the plating solution, causing it to overflow onto the floor[4].

Engineering-wise, facilities should be installed in all plating plants in such a manner that no dependence will be required on any mechanical equipment in an emergency. This means elimination of any element by which wastes could get away from the plant without treatment.

Cyanide Treatment and Disposal

Following are a few comments concerning various methods for disposing of cyanide wastes. There are many published reports on treatment processes, and for a more detailed review the "Critical Review of the Literature Pertaining to the Disposal of Cyanide Wastes"[1] is by far the best to date and should be referred to.

Inasmuch as the above-mentioned review specifically deplores the lack of published data on the disposal of cyanide by the acidification-aeration method, some of the data collected during the operation of the Willow Run Bomber Plant plating-waste-disposal facilities will be presented in more detail.

Comments are presented on the following:

1. Dilution
2. Ponding
3. Alkaline chlorination
4. Electrolytic oxidation
5. Formation of less-toxic complex ions
6. Ion exchange
7. Acidification and aeration

Dilution

Disposal by dilution of cyanide-bearing plating wastes in sewer systems represents the method used by the greater number of plating plants today, based on the limited survey of Gurnham[5]. The difficulty in using this method, however, is the necessity for controlled discharge, uniform concentration, and thorough mixing of the wastes with the diluting medium. It is fraught with the danger that one of these requirements temporarily may not be met.

However, in Detroit, Mich., for example, electroplating wastes are of little concern in the sewer system, because of the tremendous volume of diluting water available (over 400 million gallons per day).

Furthermore, the treatment plant is of the primary type with no sludge digestion. (The digestion process is the portion of the sewage plant most frequently affected by metal-plating wastes.)

In a smaller community, dilution in the sewer, if not to excess, can be utilized as a satisfactory disposal practice for low-concentration rinse waters. This is carried on successfully at the Ford Motor Company's Ypsilanti, Mich., plant in conjunction with the municipality. Formerly, dilute rinse waters went directly to the Huron River without treatment and with no apparent harm. However, they now enter the sewer system, thus utilizing an additional 40 to 1 dilution as a safety factor before they eventually reach the river *via* the sewage plant effluent. No harm to the sewage plant has been noted in following such a practice for the past two years.

Ponding

With few exceptions, ponding of cyanide wastes is an outmoded, unsafe practice. Dangers inherent in the failure of dikes, pollution of ground water, etc., make it an undesirable disposal method. Greases and solids present in spent solutions eventually seal the subsurface drainage to such an extent that ponds frequently overflow. New additional ponds are continually in demand.

With the nationwide interest in the conservation of ground-water resources, it is but a matter of time until the disposal of such toxic materials to the ground will be prohibited. In Michigan, a regulation is now being considered by the Water Resources Commission which would make unlawful the ponding of toxic wastes.

Alkaline chlorination

The oxidation of cyanide to cyanate in the presence of excess alkalinity, followed by the hydrolysis of the cyanate to carbonate, is the treatment process now generally used in new plating-waste-disposal plants in the United States. The process is quite simple, rapid, and positive, and has fewer objectionable features than the other chemical methods known. Dobson[6] reported the following reactions, which describe the oxidation:

$$NaCN + 2NaOH + Cl_2 \rightarrow NaCNO + 2NaCl + H_2O$$

$$2NaCNO + 4NaOH + 3Cl_2 \rightarrow 2CO_2 + 6NaCl + N_2 + 2H_2O$$

He cautioned against lowering the *p*H of the solution during chlorination as the toxic cyanogen chloride might be produced. In practice, either a continuous- or a batch-type treatment plant can be used and the chlorine applied either as a solution of the gas in water or as a hypochlorite solution.

Recent articles have described some of the plants using alkaline chlorination[7,8,9]. Priester[10] described an interesting, small batch-treatment plant in Pennsylvania which utilized calcium hypochlorite as the oxidizing agent.

In the new plating-waste-treatment plant of the Ford Motor Company at Monroe, Mich., alkaline chlorination will be used for the treatment of spent concentrated baths and rinse waters. The process will be of the semi-batch type, and is described briefly later in this paper.

Electrolytic oxidation

Wagner[11] recently obtained a patent covering the electrolytic process for destruction of cyanide in plating baths and recovery of metals. The process involves electrolyzing a spent cyanide bath at 200° F until the cyanide content is as low as 4 ppm. Ventilation must be provided, and aeration speeds the reaction. Current density was not considered critical. Usual plating-room equipment is used.

Sperry and Caldwell[12] reported their laboratory and plant-scale work on the same process. In the plant-scale test, 700 gal of a spent copper cyanide bath was destroyed. Cyanide was reduced from 2.83 to 0 oz/gal in 40 hr. The copper content was reduced from 2.16 to 0 oz/gal in 18 hr. Considerable data and graphs were presented, which would enable others to duplicate the work.

Kessler and Oyler[13] reported the use of the same process for destroying sludges filtered from plating solutions. They indicated the necessity for high temperature (200° F), vigorous aeration, use of copper electrodes, a high current density, and a high anode-to-cathode ratio. They also pointed out that the use of copper electrodes was not considered a cost item, as they were vehicles in salvaging the copper recovered in the process.

It would appear that electrolytic oxidation of concentrated baths will find increasing use in plating establishments.

Formation of less toxic complex ions

There are a number of processes by which hydrocyanic acid or its salts can be converted to a less toxic form. Three of these methods are:

1. Treatment with sulfur compounds
2. Treatment with iron compounds
3. Reaction with spent nickel solutions

Conversion of cyanides to the less toxic thiocyanates by boiling with a lime-sulfur mixture, or the addition of various polysulfide chemicals, has been largely superseded. A patent was issued to Wernlund and Zunick[14] covering this type of treatment. However, due to the incompleteness of the reaction, the possibility of later hydrolysis of the thiocyanate and liberation of cyanide, the large volume of sludge produced, and the excess sulfides in the effluent, the treatment has by and large been dropped.

Treatment of cyanides with iron salts produces a complex iron compound, either the precipitate Prussian blue or the soluble (Turnbull's) blue. The reaction is time consuming, and does not go to completion. Southgate[15] indicated that the reaction is already

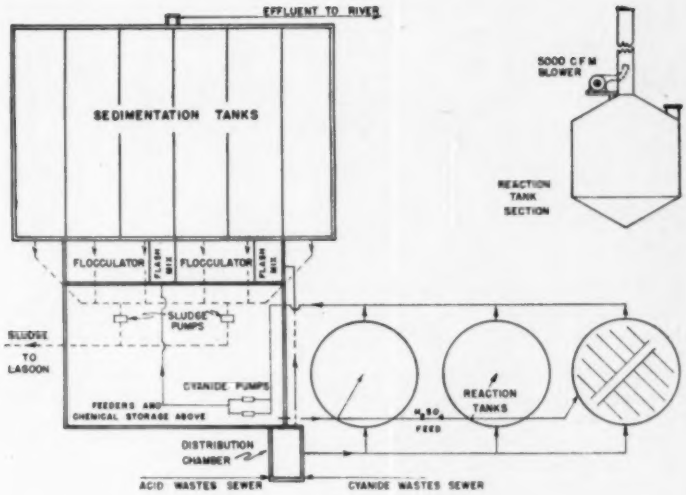


Fig. 1. Flow sheet for plating-waste treatment at Willow Run bomber plant

used on a large scale in England, but did not report any specific locations. He pointed out further that the results of experimental work on the use of ferrous sulfate and lime in the absence of air had indicated that a solution of KCN containing 408 ppm as HCN can be reduced to 0.14 ppm in 4 hr. Some work on this process was carried on in the laboratory at the Willow Run disposal plant during the war, but reaction rates with the metal cyanides were so low that the method was abandoned.

It would appear that any use of ferrous sulfate to produce complex cyanides as a disposal method should be carefully scrutinized in relation to the receiving stream. Any impoundment of the stream below an effluent discharge might be hazardous, due to the effect of sunlight and natural factors in stimulating hydrolysis and the liberation of cyanide. More data are needed on how tightly bound the complex will remain in natural water before it can be used extensively.

Milne[16] has recently presented a theoretical approach to the subject of disposal of cyanides by formation of less toxic complex ions. The chemistry of the nickelocyanide complex is dealt with in detail, and the conclusion presented that such a complexing process holds considerable promise.

Ion exchange

To date there have been many studies on ion exchange as a means of concentrating plating wastes. In general, the regeneration of solutions still remains a problem that has not been solved satisfactorily and economically.

Acidification and aeration

The process of acidification and aeration has been reported by Eldridge[17] and Oeming[18], and has been installed at the Chevrolet Motor Company plant at Flint, Mich., and the Willow Run Bomber Plant (Fig. 1). The latter was functionally designed by the writer and his staff of the Waste Section, Ford Motor Company.

Herda[19] and Bleiweiss[20] have already described this plant in detail; therefore, its description is not repeated here. Instead, a few observations and conclusions which led to the adoption of a different treatment at the new Ford Monroe plant will be given.

Fig. 2 illustrates the progress of two typical batch treatments picked at random. It will be noted that there is a fairly rapid initial reduction in cyanide, which tapers off as aeration continues.

One of the major difficulties in such acidification and aeration treatment is the slow hydrolysis of complex metal cyanides in low-*p*H solutions even with violent agitation and aeration. The free cyanide or alkaline salts are removed readily, but the metal salts

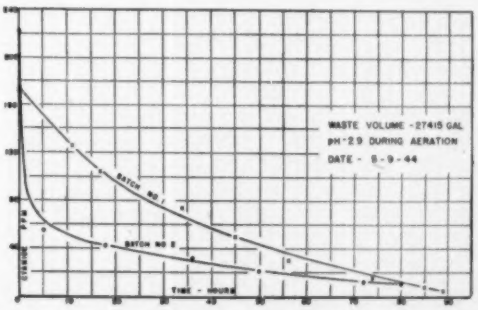


Fig. 2. Progress of removal of cyanide from two typical batches of cadmium cyanide plating waste at Willow Run disposal plant

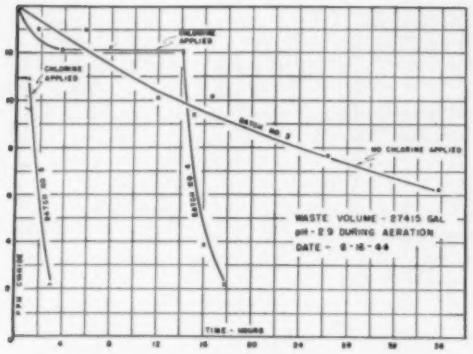


Fig. 3. Effect of chlorine addition on rate of removal of cyanide from plating-waste solutions treated by acidification and aeration at Willow Run disposal plant

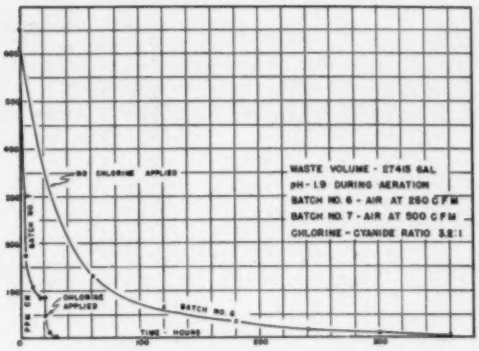

NO CHLORINE APPLIED
WASTE VOLUME - 27415 GAL
pH - 1.9 DURING AERATION
BATCH NO. 6 - AIR AT 250 CFM
BATCH NO. 7 - AIR AT 500 CFM
CHLORINE - CYANIDE RATIO 3.2:1
BATCH NO. 6
CHLORINE APPLIED
BATCH NO. 7
TIME - HOURS

Fig. 4. Effect of chlorine addition on rate of removal of cyanide from cadmium-plating waste solutions treated by acidification and aeration at Willow Run disposal plant

take so long to react completely that aeration costs become considerable. This fact was largely responsible for the decision to provide alkaline chlorination for cyanide treatment at the new Monroe plant.

In an attempt to speed up the reaction some early work was done on the addition of chlorine to the acidified cyanide wastes. Figs. 3 and 4 show the effect of adding chlorine to 27,000-gal batches of the acidified waste during aeration. The quantity of chlorine used was in the ratio of 3.2 lb per lb of cyanide. The time consumed in the latter case was limited by how fast the chlorine could be applied. The addition of chlorine reduced the usual aeration time from 360 to 30 hr. The bomber plant was abandoned by the Ford Motor Company shortly after this work was started, and no further quantitative data are available.

Treatment of Chromium Wastes from Plating Baths

The following is a classification of treatments of chromium wastes as proposed by Grindley[21]:

1. Reduction methods.—Addition of a reducing agent to reduce the hexavalent chromium to trivalent and subsequent treatment with alkaline agent to precipitate the chromium as hydroxide.

2. Precipitation methods.—Direct precipitation of chromium as an insoluble salt of chromic acid.

3. Absorption methods.—Removal by ion exchange.

Of the many chemical reducing agents for reduction of chromium studied by Hoover and Masselli[22], those most commonly used today are ferrous sulfate, sulfur dioxide, and sodium metabisulfite.

At the Willow Run plant mentioned earlier, a solution of commercial ferrous sulfate was used and found very satisfactory. Reduction of the chromium was rapid in the acid solutions (pH 2.5–3.0); hexavalent chromium was consistently absent in the effluent of treated batches of wastes. The major objection to its use was the voluminousness and poor settling characteristics of the sludge. Fig. 5 is a graph prepared by Madarasz[27], while chemist at the Willow Run waste-disposal plant, showing the volume occupied by increasing quantities of chromium following reduction with ferrous sulfate and neutralization with lime. The sludge is light, does not compact well, and is difficult to keep from being carried over the effluent weirs of conventional settling basins. The solids content of the slurry pumped to the lagoon from settling basins is very low; for example, at Willow Run, about 0.5 per cent solids by weight. Rates of flow through up-flow clarification units can be expected to be much lower when ferrous sulfate is used instead of sulfur dioxide or sodium metabisulfite.

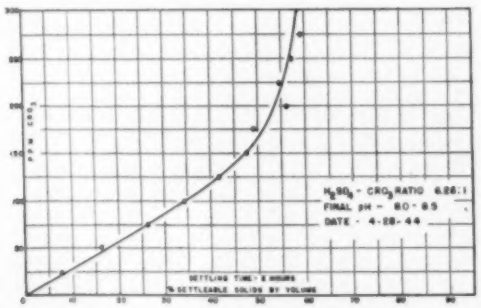


Fig. 5. Volume of sludge produced by treatment of chromic-acid waste solution with ferrous sulfate and lime

Sodium metabisulfite is used at the Electric Auto-Lite's plating-waste-treatment plant at Lockland, Ohio, and seems to be a very convenient reducing agent insofar as material handling at the treatment plant is concerned. It is slightly more expensive than sulfur dioxide or ferrous sulfate. However, according to Reed[24], chemist in charge of waste treatment, the ease

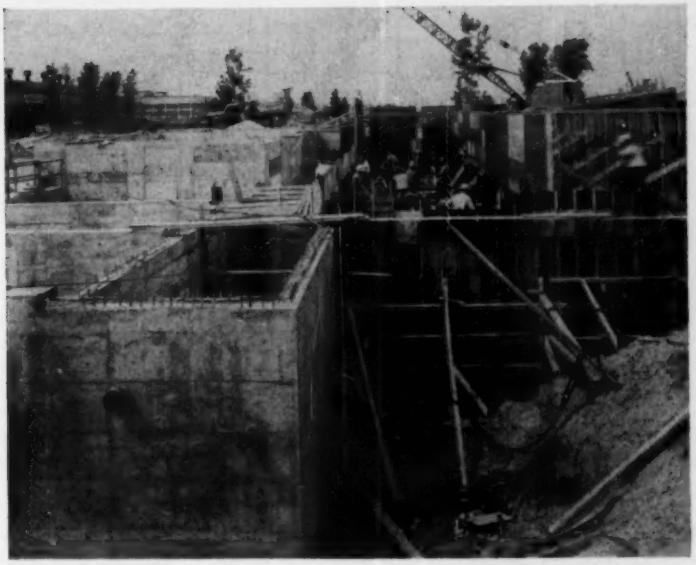


Fig. 6. Construction underway of the combined water-softening and plating-waste-treatment unit at Ford Motor Company's Monroe, Mich., plant

of handling more than offsets the difference in unit costs. It is fed continuously with ordinary dry-feed machines.

Sulfur dioxide is frequently used for reducing chromium in acid solution. A recent installation is at the King-Seeley Corporation, Dexter, Mich. The SO_2 is purchased in cylinders and, with a machine similar in construction to the well-known chlorinators used in water and sewage treatment, fed to the rinse-water continuously entering the treatment plant. Quite an excess of the chemical appears to be required in plant practice over that theoretically needed to reduce the chromium. With this exception, it is a very satisfactory treatment process.

Precipitation methods have been reported in England by Grindley[21] and in the United States by the Connecticut State Water Commission[24]. Having had no experience with this particular method of chromium removal, the author reserves comment. Literature references are rather meager, and detailed information is lacking concerning plants which have used the method.

Ion-exchange studies have been carried out by a large number of investigators during the past few years. The development of improved cation and anion exchange resins has accelerated the research effort directed at finding a commercially feasible process for concentrating chromium from waste waters. As in the case of cyanide removal by ion exchange, complete regeneration of the resin still remains a difficult matter. Southgate[25] summarized his chapter on methods of chromium-waste treatment with the observation that "it has great promise as a method of recovery of valuable material".

Of interest to those concerned with plating-waste problems will be the new combined water-softening and plating-waste treatment plant now under construction at the Ford Motor Company's Monroe, Mich., plant (Fig. 6).

As at Willow Run, the plant was functionally designed by the staff of the Special and Sanitary Engineering Section, Office of Plant Engineering, Ford Motor Company, and detailed construction plans and specifications were prepared by George E. Hubbell, consulting engineer, Detroit.

The plant is unique in many ways, not the least of which is the general layout (Fig. 7), which permits the use of the chemical feeders, laboratory, operators, etc., for either water treatment or waste treatment. Equipment is available for the complete treatment of 800 gallon per minute of acid wastes containing chromium, nickel, etc., and 300 gallon per minute of cyanide wastes. Although the volumes are large, a semi-batch treatment plant is provided to give better assurance that wastes will be adequately treated.

Four 200,000-gal acid-proofed concrete holding tanks are provided to collect acid wastes. When a tank is full and analysis of its contents is completed, treatment on a continuous basis at 800 gallon per minute is started. Ferrous sulfate, sodium metabisulfite, or sulfur dioxide is added as desired, mixed for 5 to 15 min, lime is added, and the flow again mixed. It then passes into one of two Walker "Clariflow" units, where the sludge settles out. The effluent goes to the sewer or, in case of inadequate treatment, can be returned to an empty holding tank. Arrangements are included to use waste steel-pickling liquor from the Rouge plant as a source of ferrous sulfate, if desired.

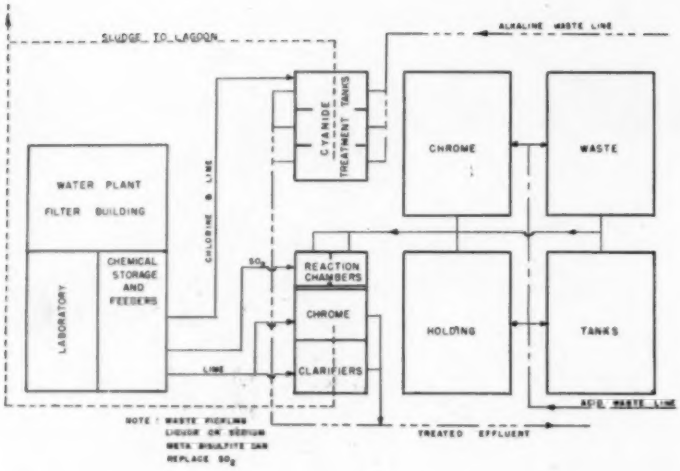


Fig. 7. Flow sheet for plating-waste treatment at Ford Motor Company's Monroe, Mich., plant

Cyanide wastes will be collected in one of three 20,000-gal holding and mixing tanks and treated with chlorine and lime. Sludge will be pumped to a lagoon and the treated effluent to the sewer.

The water plant is a 4,000,000-gal/day lime-softening plant utilizing Lake Erie as the source. Low tolerances for both suspended and dissolved solids and for hardness require a high degree of purification. Provision for split treatment is provided with the two "Clariflow" settling units. Four conventional rapid sand filters and filter-and-chemical building complete the major units. The plating-waste portion of the plant will be the largest yet built in the world, and more detailed reports on its design and operation will probably be forthcoming in the future.

It might be of interest that one of the most perplexing problems in plating-waste-treatment plant design and construction is the proper and intelligent choice of special materials of construction, such as coating materials, metals, etc. An investigation and report on experience with materials which have been used in plants would be most welcome.

Other observations involving the future and its effect on plating wastes include:

1. Utilization on a broader scale of the relatively nontoxic metal pyrophosphate salts in place of metal cyanides in plating baths provides a means by which some plating plants may reduce their cyanide problems.

2. The expanded use of "gas plating"[16] with metal carbonyls is on the horizon. Its impact may reduce stream pollution by eliminating liquid plating baths. However, increased air-pollution hazards might offset the gains.

Discussion of the controversial subjects of stream standards, laboratory methods, effects on sewage plants, etc., are items which have been left out of the paper intentionally. Nevertheless, they are extremely important and require consideration in any plant design.

Summary

1. The American Electroplaters' Society is actively assisting its membership with plating-waste disposal problems. Its critical review of the literature[2] is the most useful source of information yet available.

2. Solution of plating-waste problems should start within the plant. Areas around tanks containing toxic chemicals should be curbed and a separate mat underneath should drain by gravity any accidental spills or leaks to a nonoverflowing tank.

3. Reclaim rinse tanks should be required following all concentrated plating baths.

4. Adequate initial plant design or physical changes of existing plants should be the first and guiding principle in the elimination of plating waste.

5. Of the many methods available for cyanide-waste treatment, alkaline chlorination is the one recommended and now in general use.

6. Use of chlorination in acid solutions at the Willow Run bomber plant is reported briefly.

7. Chromium wastes are most readily treated by reduction and precipitation with lime. Sulfur dioxide and sodium metabisulfite are preferred reducing agents; however, a local source of waste acid-pickling liquor may make ferrous sulfate more advantageous.

8. The new Ford-Monroe plating-waste-treatment plant, which will be the largest yet installed in the country when completed late in 1950, is described briefly.

9. Mention is made of the possible use of metal pyrophosphates in place of metal cyanides to eliminate cyanide completely from plating rooms.

10. Mention is also made of the future use of the "gas plating" carbonyl process.

11. A plea is made for more studies and publications on the specialized construction materials used in

(*Continued on page 357*)

CHEMICAL DEPOSITION OF SILVER ON NONCONDUCTIVE BODIES

JOHN T. OWEN

Merck & Company, Inc., Rahway, N. J.

THE CHEMICAL DEPOSITION of silver on glass dates back over a century. Baron Justus von Liebig (1835) discovered that an ammoniacal solution of silver nitrate, with an aldehyde as reducing agent, would deposit a silver film on glass when slightly warmed. With the improvements that followed, in which various reducing agents were used, progress was rapid, and it was not long before the mercury-tin mirror became just a museum piece.

This article was prepared primarily as a summary of the chemical deposition of silver on nonconductive bodies by the spray method, but because of the analogies, the preparation of solutions and objects for other methods will be disclosed also.

Silvering is not usually considered a dangerous process. It is advisable, however, to make all cognizant of the incident dangers, and as we proceed the need for certain precautions will be indicated.

All chemicals used in the preparation of solutions must be of the highest purity, as the use of impure products may result in failure. Therefore, cp or reagent-grade chemicals should always be used.

All objects to be silvered, as well as the utensils used in making and storing solution, must be exceptionally clean.

Preparation of the Silvering Solution

Practically all methods for the chemical deposition of silver on nonconductive bodies use an ammoniacal solution of silver prepared by adding ammonium hydroxide to an aqueous solution of silver nitrate. From this solution the silver is precipitated in metallic form by the addition of a suitable reducing agent.

In making the silver solution it is imperative not to add too much ammonia and thereby produce a clear solution before filtering. The ammonia should be added gradually, and the addition should be discontinued just short of clarity. After filtration, the solution should be crystal clear.

Caution.—In the ammoniacal solution of silver nitrate, compounds may form which are violently explosive and which may detonate by pressure or jarring. Incidents have been recorded where explosions of this nature have resulted in injury to the operator or have been of sufficient violence to produce property damage. Although explosions seem more likely to occur when a formula is used in which potassium or sodium hydroxide is one of the constituents of the silver solution, as in the Brashear method, it is possible to produce explosive mixtures, if precautions are not taken, by the addition of ammonia alone.

Residue remaining after the making of silver solutions should never be allowed to become dry, filter paper should be disposed of immediately after use, and all vessels used in the preparation of the silver solution should be carefully cleaned. Residues can be thrown into a water solution of common salt and the silver recovered as a precipitate and sent to refiners for conversion to the metal.

Courtesy J. L. Sommer Mfg. Co., Newark, N. J.

Storage.—All bottles containing silver solutions should be kept tightly stoppered when not in use and if possible always stored in a cool place in amber or other dark-colored bottles. Silvering solutions made by the Brashear process *should not be stored* but prepared only as required.

Silvering of Glass

Preparation of the glass

After the glass has been thoroughly rouged and the rouge washed off, the glass is sensitized with a solution of reagent-grade stannous chloride in distilled water (0.25 oz/gal; 2 g/l). This sensitizing solution is made fresh every day, and a piece of pure tin metal is kept in it at all times to prevent some of the stannous chloride from being oxidized to the stannic state, in which it would lose its effectiveness as a sensitizing agent.

The glass surface is thoroughly washed free of the sensitizer, given a distilled-water rinse, and placed on a table on a level plane.

Silvering and backing

The glass receives the pouring solution, which consists of equal volumes of the silvering solution and the chosen reducing solution. Within a minute or so, metallic silver begins to deposit, and after 15–20 minutes, a silver film of sufficient thickness to make a good mirror has been deposited. The sludge is washed off, and when the back is dry it is ready to receive a first backing, which consists of a thin coat of shellac; when this is dry, a coat of paint or other conventional second backing follows.

Solutions

The formulas that follow are not exclusive, but are found to be satisfactory for general use. Although the information is from reliable sources, we are not responsible for results.

Brashear formula (Cold table process)

Again, do not store the silver solution made by this method; *make it up only as needed.*

Silver solution

1. Dissolve 1 oz (28 g) Merck cp silver nitrate in 1 pint (475 ml) of distilled water.
2. Add Merck cp ammonia water until the precipitate formed barely redissolves; the end point should be just short of clarity.
3. Dissolve ½ oz (14 g) reagent-grade sodium or potassium hydroxide in 1 pint (475 ml) distilled water and cool to room temperature.
4. Add the potassium or sodium hydroxide solution slowly with stirring to the ammoniacal silver nitrate solution.
5. Add dropwise with stirring a 5 per cent solution of silver nitrate until a slight turbidity forms and persists.
6. Filter through No. 1 Whatman's filter paper or its equivalent.
7. Make up to 1 gallon (3785 ml) with distilled water.

Reducing solution

The most generally used reducing solution for the Brashear formula contains dextrose, with or without small amounts of formaldehyde. Although many others can be used, dextrose or inverted sucrose seems to give best results.

1. Dissolve 1.9 oz (54 g) cp dextrose in 1 quart (950 ml) distilled water.
2. Boil for 10 minutes, cool, and filter through No. 1 Whatman's filter paper or its equivalent.
3. Make up to 1 gallon (3785 ml) with distilled water and add 0.067 fl oz (2 ml) 38–40 per cent reagent-grade formaldehyde solution.

Silver pouring solution

When ready to use and then only, mix rapidly equal volumes of silvering solution and reducing solution. Pour the combined solution, at room temperature, upon the freshly prepared glass surface.

Rochelle salt formula (Hot table process)

Stock Silver Solution No. 1

1. Dissolve 1 lb (450 g) Merck cp silver nitrate in 1 pint (475 ml) of distilled water.
2. Add slowly, with stirring, sufficient cp ammonia water until the precipitate formed barely redissolves; the end point should be just short of clarity.
3. Add dropwise with stirring a 5 per cent solution of silver nitrate until a slight turbidity forms and persists.
4. Filter through No. 1 Whatman's filter paper or its equivalent.
5. Make up to 1 gallon (3785 ml) with distilled water, and place the solution in a well-stoppered amber- or dark-glass bottle.
6. Store in a cool place.

Stock Reducing Solution No. 2

1. Dissolve 1¾ lb (795 g) Rochelle salt, ¼ lb (113 g) Epsom salt and 0.018 oz (0.5 g) silver nitrate in 1 gal (3785 ml) distilled water.
2. Boil for 10 minutes and filter through No. 1 Whatman's filter paper or its equivalent.

Silvering Solution

Dilute 8 fl oz (30 ml) of stock silver solution No. 1 to 1 gal (3785 ml) with distilled water in amber or dark colored bottle. Keep well stoppered.

Reducing Solution

Dilute 8 fl oz (30 ml) of stock reducing solution No. 2 1 gal (3785 ml) with distilled water. Clean glass bottles are suitable for this solution. Keep well stoppered.

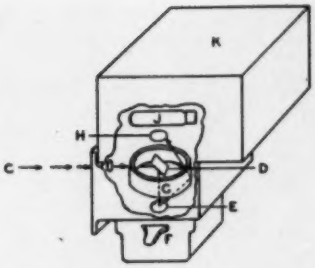


Fig. 1. Optical System of Beckman diffuse-reflection attachment for use with Model DU Spectrophotometer. In normal operation, light from monochromator C is reflected by flat mirror D to surface of sample E inclined in sample-holder drawer F so that light reflected from the sample strikes inner surface of ellipsoidal mirror G and becomes focused on quartz diffusing screen H. The screen lies in the field of view of the phototube J, which measures intensity of the reflected light. Essentially a single beam is utilized in this method, only a small segment of G being employed. When sodium chloride crystals are employed, mirror sample is mounted flat, and scattered radiation from crystals are collected around and focused by entire inner surface of G

Silver pouring solution

Mix rapidly equal volumes of silvering solution and reducing solution. Pour the combined solution, at room temperature, onto the freshly prepared glass surface.

Spray Process

The stock silver solution and the silvering solution for the hot table process are the ones in general use for spraying.

Many types of reducing solution are used in conjunction with the silver solution in the spray process, and they must be formulated with care.

Either a double-nozzle gun or two separate guns are used. One gun or nozzle sprays the silvering solution while the other sprays the reducing solution. The guns or nozzles are so arranged that the two sprays come together just before they make contact with the object to be silvered.

Silvering of Plastics

Whereas the silvering of plastics or other nonconductive bodies by the spray process does not offer too many complications, great care must be taken in preparing the object prior to sensitization. Lubricants that are incorporated within the plastic or that have been used for mold-ease are difficult to remove from the surface of the plastic. One of the methods now in use involves coating the plastic with a thin layer of lacquer; after the lacquer has dried or been baked, the article is washed in a weak detergent solution. This solution should not contain the ordinary fatty-acid soaps but should have incorporated a surface-active agent or contain soap bark alone. After a good wash in one of these detergent solutions, the plastic is washed thoroughly with water and sensitized with stannous chloride solution (1/8 oz/gal; 2 g/l) either by dipping or with a spray gun. The sensitizing solution is then thoroughly washed off, and silvering begun immediately.

Parts to be electroplated after silvering require methods of preparation which will assure the formation of a strong bond between the silver and the plastic. For this purpose it has been customary to roughen the surface slightly either chemically, or mechanically, e.g., by light blast with 220-grain aluminum oxide or the like, or by tumbling with an abrasive such as 100-110-mesh pumice. Whether such roughening is required must be determined by experiment. Some studies indicate that a thin coating on the plastic of thermosetting-resin varnish which has beenpartially polymerized before silvering will furnish an excellent bond when the polymerization is completed by drying the silvered item in an air current of moderate temperature.

Lacquer Coating and Coloring of Silvered Plastics

After the objects have been sprayed with silver, which usually takes 10–20 seconds, they are thoroughly washed with water and dried. They are then given a coat of protective lacquer, which may be either transparent or colored. When clear lacquers are used and coloring is desired, the lacquered parts are dipped into a coloring solution to which the particular type of lacquer coating is receptive.

Some of the concerns manufacturing lacquer, dyes and reducing solutions are well qualified and do give purchasers ample instructions in the use of their products.

Plating on Silvered Plastics

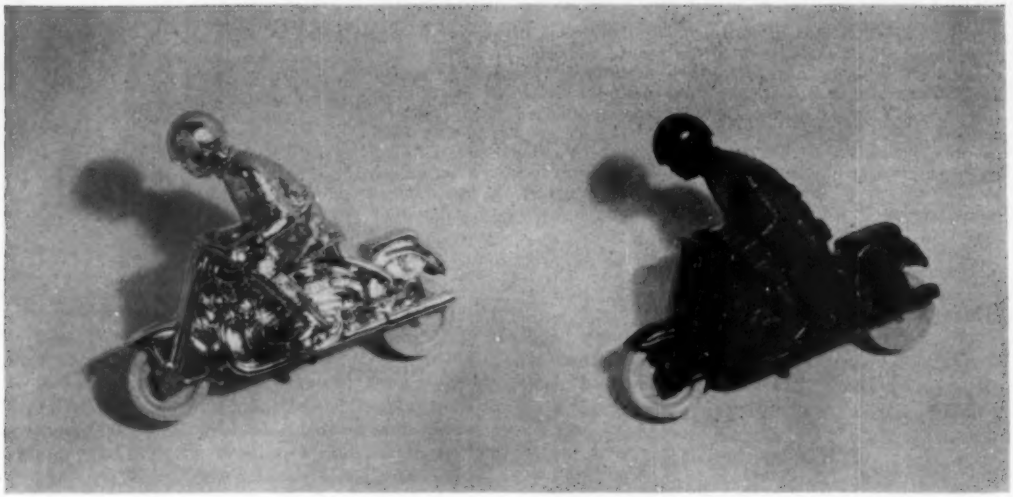
The conventional Rochelle salt copper solution is commonly used for the first deposit on top of the silver film. This deposit may then be followed by deposits from a conventional copper sulfate bath or from any other plating bath as required, providing that the coating is not highly stressed.

Mirror Reflectance*

For the measurement of brightness on mirrored or highly polished surfaces our Analytical Research Department has used two techniques in attempting to utilize the Beckman Model DU spectrophotometer with diffuse-reflectance attachment.

In this instrument white light (incandescent bulb) is passed through a monochromator (quartz prism). By means of a slit and optical mirrors, the resulting beam of monochromatic light (of any desired wave

*By H. A. Frediani (Merck Analytical Research Department).



Courtesy J. L. Sommer Mfg. Co., Newark, N. J

length in the visible region), which is of relatively high spectral purity, is made to impinge on the surface of the sample to be measured. This sample is placed within an integrating ellipsoid, a circumferential segment of which is used to pick up the radiation scattered by the sample and focus it upon a phototube. By this very design, only scattered radiation may be measured, and reflection from highly polished surfaces is normally not measurable.

The relative intensities of lights reflected by two surfaces are compared by mounting the surfaces at an angle of 30–50° to the horizontal plane so that the reflected light does impinge on the segment of the integrating ellipsoid used for pickup (Fig. 1). However, the mounting angles are critical and hard to duplicate. Also, no reference standard can be used to correlate results obtained at different times.

More rigid and reproducible comparisons have been made possible by the use of a different technique This is essentially as follows:

A National Bureau of Standards reflectance standard is placed in the holder, and the instrument is adjusted to indicate the certificate value (compared against magnesium oxide film as 100 per cent). The mirror to be tested is then placed in the adjacent holder, a weighed amount of crystalline sodium chloride is spread to cover approximately half of the exposed surface, and the reflectance of this specimen measured. The value recorded will be a measure of the reflectance of the sodium chloride as augmented by the mirrored surface. A surface having higher reflectance will, of course, enhance the value obtained more than a mirror having poorer reflectance. By this technique it is possible to correlate results against a known standard, and hence more rigid comparisons are possible. The values obtained are essentially a measure of the brightness of the surface.

TABLE I. COMPARISON OF REFLECTANCES FROM BACK-SILVERED AND FRONT-SURFACED MIRROR SURFACES BY THE SODIUM CHLORIDE METHOD

Wave length used: 510 mμ
Standard used: 88 per cent reflectance

% Reflectance of NaCl on			Increase in % Reflectance with	
Black Body	Back-silvered Sample	Front-surfaced Sample	Back-silvered Sample %	Front-surfaced Sample %
30	57	51	90	70
29	59	50	100	70
29	58	51	97	75
30	59	49	97	65

The results in Table I were obtained on a "back-silvered" and a "front-surfaced" 1-inch-square sample and indicate the reproducibility that is possible to obtain.

The enhancement of the reflectance is indicated in the last two columns by the difference between the samples with the mirrors on one hand and the sample with black background on the other.

A compact sample of the sodium chloride used showed essentially 100 per cent reflectance. The distribution of the salt over the surface does not seem critical so long as a single layer of crystals is formed. For more critical evaluation of this technique, it would

be necessary, of course, to investigate the effect of crystal-size variation.

Film Thickness

A method devised by Fizeau and described in National Bureau of Standards Circular No. 389 is convenient for determining the thickness of a silver film. A very small crystal of iodine is placed on a flat surface, and the part bearing the silver film to be measured is supported so that the film is 1 or 2 mm (0.04 or 0.08 inch) above the crystal. After a few minutes the iodine vapor will have converted the silver immediately above the crystal into silver iodide and thus produced a transparent spot in the film. Neighboring portions of the film will have been partially converted into silver iodide, and as a result, when the film is viewed by reflected light, the transparent spot is seen surrounded by a series of concentric colored rings corresponding to the variations in thickness of the layer of silver iodide.

TABLE II. DETERMINATION OF THICKNESS OF SILVER FILM FROM NUMBER OF SILVER IODIDE RINGS

Number of Rings	Film Thickness	
	mm x 10^{-6}	inch x 10^{-7}
2	31	12
3	61	24
4	92	36
5	123	48
6	154	61
7	215	85

It is essential that the film be exposed to the iodine until the central part of the pattern is transparent. A longer exposure will increase the size of the pattern, but will not increase the number of rings. The number of rings present is a measure of the thickness of the silver iodide at the center of the pattern, and this in turn is a measure of the amount of silver originally present, i. e., a measure of the thickness of the film.

To determine the thickness of film, the number of concentric ring systems is counted and reference is made to Table II. The values in the table are computed from the relative densities of silver and silver iodide and from the refractive index of silver iodide.

If it is not convenient to invert the silvered part over the crystal of iodine, the crystal may be laid on the silver film and a small beaker inverted over it to shield it from air currents. This, however, does not yield the symmetrical pattern which is obtained when the iodine does not actually touch the silver film.

The thickness of a silver film may vary from 30 millionth of a millimeter (1.2 millionth of an inch) for a very thin film to approximately 200 millionth of a millimeter (8 millionth of an inch) for a very thick film.

Plating Wastes

(*Continued from page 352*)

plating-waste plants. Experience with various types of metals, coating materials, etc., is needed.

Acknowledgments

Grateful acknowledgment is given to M. F. Madarasz, supervisor, Water and Waste Laboratory; F. J. Kallin, supervisor, Sanitary Engineering Section; and V. F. Duranceau, chemical engineer, Special Engineering Section, all of the Ford Motor Company, for their assistance in reviewing this paper, in preparing the illustrations, and in other technical matters.

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Washington Orders

Copies of NPA orders and publications may be obtained from National Production Authority, Washington 25, D.C., or from any of its local offices.

Zinc.—NPA order M-37, dated February 14, limits zinc-scrap inventories and regulates zinc-scrap toll agreements. Its effect is to forestall excessive conversion of zinc scrap into slab zinc at the expense of the zinc-dust supply. Zinc-dust production approximates 30,000 tons a year. About 80 per cent is recovered from zinc dross, most of which results from hot-dip galvanizing. Zinc dust is used to some extent to purify zinc and cadmium plating solutions.

Lead and antimony.—NPA orders M-38 and M-35, issued on February 16, limit inventories of lead and antimony, respectively, and materials containing these metals to 60-day supply or a "practical minimum working" inventory, whichever is less. Antimony is used to harden lead alloys. U. S. consumption of lead is over 1 million tons per year of which ¼—1/3 is imported. Antimony is largely imported from Bolivia and Mexico, domestic mines being able to supply at best 6,500 tons, or ¼-1/3 of the domestic consumption.

Representatives of the telephone and telegraph industry, at a meeting with NPA officials on February 20, reported the use of lead for zinc in some galvanized coatings on hardware.

Copper.—The basic copper conservation order M-12 was amended on February 19 to permit the use of copper and copper-base alloy for plating undercoats for chromium, nickel, gold and silver. It also permits brass plating, where other types of finishes are not practicable, on builders' hardware on List A of prohibited uses of copper. The order adds a List B of items for which the use of copper is prohibited after April 1. Anyone holding copper in inventory on March 1 or included in the producers schedule for February and delivered before April 1 may use it to make List A items, provided the copper is wholly unsuitable for use by the person holding it in the manufacture or assembly of items not on List A. A similar provision holds for List B items, except that all dates are one month later.

Tin.—The can order M-25 was amended on February 23 to include some minor changes.

At a meeting of representatives of the tin plate industry on February 15, reference was made to the process recently initiated by one tin-plate producer to reduce the tin thickness on the outside of the container. This year some 42 million containers will be made with electro tin coating, some 26 million with hot-dip tin coating, and about 17 million of black plate, it was stated.

Nickel.—The basic nickel order M-14 was amended on February 28 to permit a person to use nickel plating on the prohibited items in List A as long as his nickel inventories hold out, provided that (1) the nickel was contained in his inventory on March 1 or (2) that it was covered by an order placed with a producer and included in the producer's schedule for February delivery and is being delivered to the person's plant prior to June 1, but in both cases only to the extent that the nickel is wholly unsuitable for use in production, manufacture or assembly by such person of any item not prohibited in List A. As distinct from other forms of nickel, nickel anodes may be used for plating items on List A only if such anodes were in the inventory of the person doing nickel plating on March 1 and they are wholly unsuitable for other use by the person.

The plumbing goods industry, at a meeting of its advisory committee with NPA officials on February 14, was advised to reduce the thickness of plate used. The industry representatives replied that it has already taken such steps, adding that plating of plumbing fixtures is necessary for sanitation purposes.

Members of the Hand Service Tools Industry Advisory Committee, at a meeting with NPA officials on February 8, complained about difficulties in obtaining nickel for plating. They were advised that assistance will be considered in case of individual hardship.

Maintenance, repair and operating supplies.—All business enterprises, government agencies and institutions may now apply an extendible DO rating, DO-97, to obtain needed maintenance, repair and operating supplies. This new Regulation 4, dated February 27, includes certain quota restrictions.

Inventories and priorities.—A pamphlet, "Inventory Control and Priorities", was issued on February 1 to answer 85 questions most frequently asked of the NPA with respect to the application of NPA Regulations 1 and 2 to industry and business.

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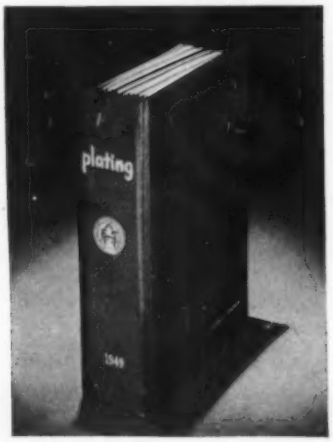

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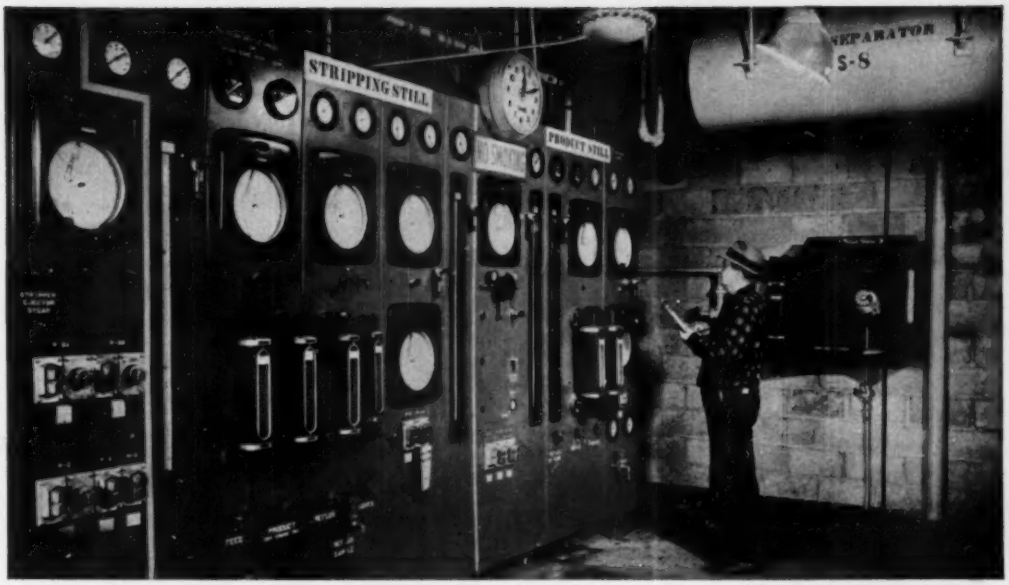

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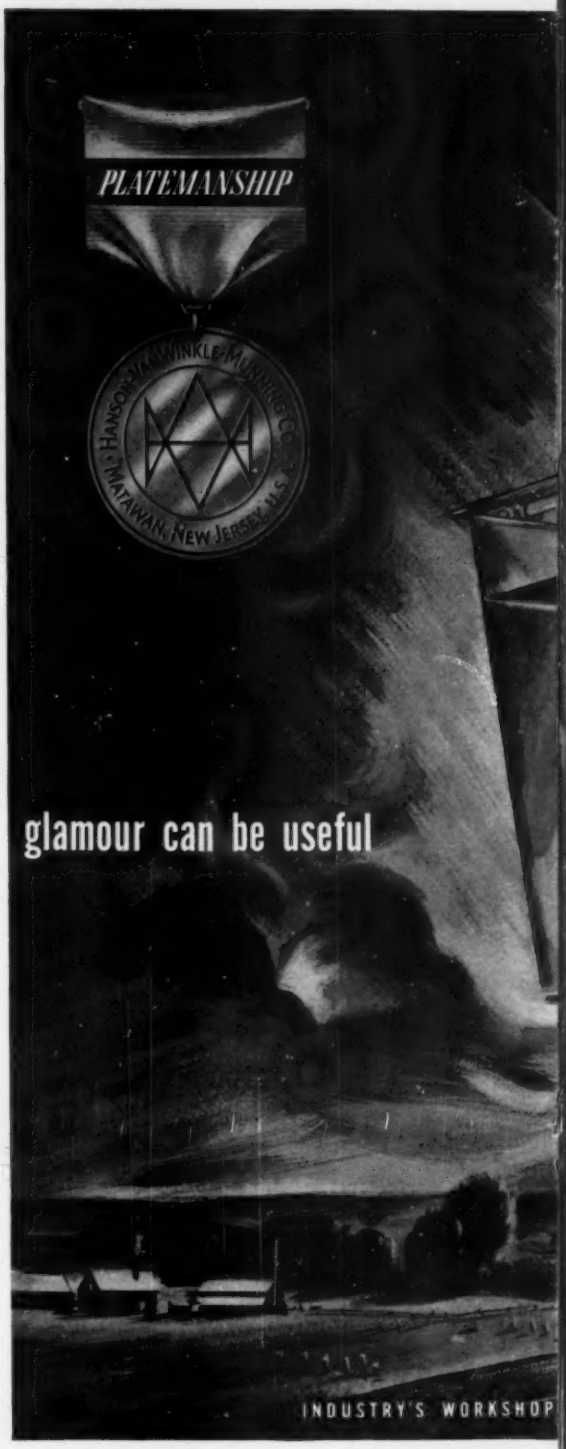

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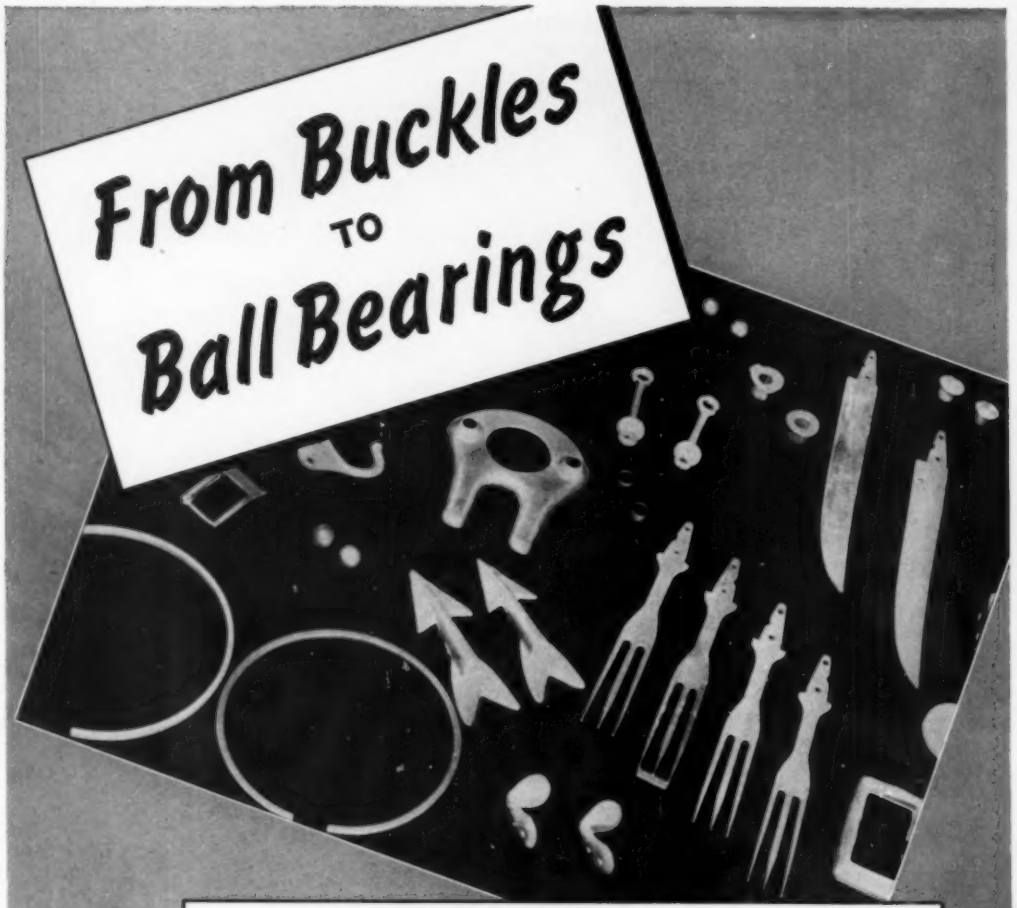

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A MICROHARDNESS TESTER FOR METALS AT ELEVATED TEMPERATURES

By ABNER BRENNER

National Bureau of Standards, Washington, D. C.

Introduction

The hot hardness of a metal is an important indication of its performance in certain applications at elevated temperatures. Inasmuch as there is usually a relationship between the hardness of a metal and some of its other mechanical properties such as tensile strength, a measurement of hardness may be useful for obtaining an estimate of those mechanical properties which are more difficult to measure. The development of a microhardness tester which could be used for testing electrodeposits at elevated temperatures was undertaken in connection with studies of electrodeposited metals and alloys.

The hot hardness of bulk metals has been measured by the methods used at room temperature, and a variety of indenters have been used to produce indentations by static or dynamic loading[1,2,3]. The only suitable indentor for metallic coatings is a pointed diamond with which a micro-indentation may be produced with a small load. Hot-hardness testers with diamond indenters for use with heavy loads on massive metals have been designed by Bens[4] and by Bishop and Cohen[5].

The thinness of electrodeposited coatings dictates the use of small loads, and it was necessary, therefore, to design a new instrument around this requirement.

Design of the Microhardness Tester

The hot-hardness tester described herein follows to some extent the designs of Bens[4] and of Bishop and Cohen[5]. Two difficulties are involved in microhardness testing at elevated temperatures. (1) A closed system with an inert atmosphere must be used to prevent oxidation of the specimens. If the specimen were allowed to oxidize, the thickness of the oxide film might be comparable to the depth of the indentation produced with a light load, and the hardness of the film might be quite different from that of the metal. Also, oxidation occurring after a micro-indentation had been made would obliterate the impression. (2) In order that a light load be applied accurately, the shaft carrying the indenter must move accurately in a bearing with very little friction. There must be no galling of the bearing at the elevated temperatures. Because a closed sytem must be used to prevent entrance of air, the clearance between the shaft and the bearing must be small.

These problems were met by using as an indenter shaft a capillary tube of fused silica which moved in an inert atmosphere through a dry bearing lubricated with graphite. The clearance between the shaft and the bearing was about 0.001 inch (0.025 mm), and the inert gas escaped slowly through this space during the test. The friction of the shaft in the bearing was equivalent to one or two grams at room temperature and was probably less at elevated temperatures because the clearance between the bearing and the indenter shaft increased.

The complete tester is shown schematically in Fig. 1. It is self-contained inasmuch as the loading mechanism, indenter, and furnace are all built into one compact unit. The load is applied to the indenter by dead-weight loading, although the internal gas pressure is an important factor in the determination of the actual value of the load.

The main parts of the tester will now be described briefly. The muffle D (Fig. 1) was made by welding together sections of heavy-walled stainless-steel pipes. The anvil E is a solid piece of stainless steel welded in the muffle D. It is provided with a small hole extending to within 3 mm (⅛ inch) of the upper surface to accommodate a thermocouple F. The flange H is bolted to the top plate of the tester with a silver gasket to make the apparatus gas-tight. A doughnut-shaped disc of insulating brick J in the space within the flange decreases the heat transfer to the top plate of the tester. Uniform heating of the muffle unit is achieved by encompassing all four limbs with a continuous length of No. 16 Nichrome wire wound on an Alundum form. The space between the furnace unit and the main shell K is filled with insulating material. The relative motion between various parts resulting from thermal expansion is minimized by making the muffle assembly a single welded unit and by supporting it from a single point.

The indenter fitting B is attached to a tungsten rod

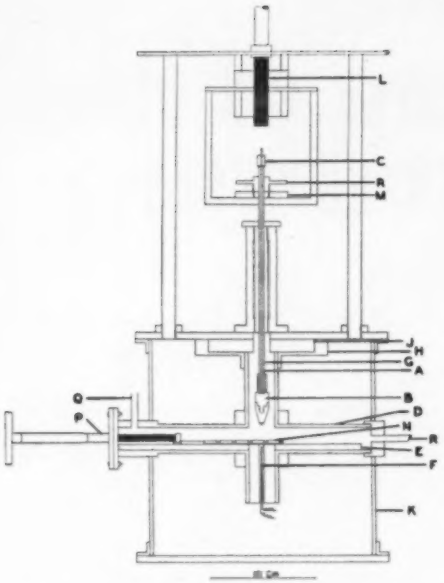

Fig. 1. Schematic cross-section of hot-hardness tester. The components designated by letters are described in the text

A which passes up through the capillary tube G and is held by a collar and set screw C. A spring arrangement holds the tungsten rod under continuous tension and thus allows for its lengthening because of thermal expansion. This indirect method of securing the indenter to the shaft was necessary because a fused silica rod could not be anchored directly to the indenter fitting.

The indenter assembly is raised and lowered at the rate of 2 cm (0.75 inch) per minute by a small motor which operates a simple screw mechanism L similar to that used on the compound rest of a lathe. The vibration of the motor is damped by a rubber mounting, and no difficulties are encountered from this source. The disc M which supports the indenter assembly rests on two pieces of rubber tubing which serve to provide a gradual application of the load when the supporting frame is lowered away from the assembly.

The indenter assembly weighs about 200 grams. This was the maximum load applied to the tests, although larger loads could be applied by placing doughnut-shaped weights on the top of the indenter assembly at R. Lower loads are normally used at elevated temperatures. These are obtained by increasing the gas pressure in the tester. Each increment of pressure equal to a centimeter of mercury is equivalent to a decrease of 7 grams in the load applied to the indenter. The smallest load used in the tests was about 30 grams.

The assembly for holding and moving the specimens is also shown in Fig. 1. The specimens measure 6 x 6 x 12 mm (0.25 x 0.25 x 0.5 inch) and are polished by metallographic procedures. Six specimens may be indented in one heat. They fit into the carriage N which slides in a keyway on the inside of the muffle. The carriage is moved by a stainless-steel micrometer screw P which has been plated with a cobalt-tungsten alloy to prevent seizing at elevated temperatures. The micrometer serves to locate an indentation within about 0.2 mm (0.008 inch) of a desired spot.

Because the indentations are microscopic in size, they are difficult to locate in the small field of a microscope when measurements of the diagonals are made. For this reason a fitting was designed to hold the carriage in a definite position on the moving microscope stage. When the microscope stage is set at the same reading as that on the micrometer P when the indentation was made, the impression appears in the field.

The inlet for the inert gas is shown at Q, and a vacuum pump is connected to the system at R. The inert gas is passed over heated copper to remove oxygen and then through a drying tube before it reaches the furnace. The flow of gas is measured with a flow meter and is of the order of 60 ml/min, under a pressure of from 3 to 25 cm of mercury. The tester is kept under a positive pressure of gas during the heating cycle both to regulate the load on the indenter and to prevent the entrance of air, as the apparatus was not vacuum tight. The pressure in the apparatus may be kept constant without difficulty by regulating the needle valve on the gas tank and a needle valve on the exist end R of the system.

The temperature of the furnace is measured by a thermocouple F which is placed in the cavity extending up through the anvil. In preliminary work the temperature within the muffle was measured also with a thermocouple inserted through the top bearing of the tester. The two thermocouples agreed within about 5 or 10° C (9 or 18° F). The temperature is automatically controlled by a commercial pyrometer.

In addition to its use for measuring the hot hardness of electrodeposits, the microhardness tester may be used for testing bulk metals and has several advantages over the two instruments on which it was based.

(1) It is a self-contained instrument, and incorporates within one unit both the furnace and the device for loading the indenter.

(2) Six specimens may be tested in one heating cycle.

(3) The micrometer screw permits indentations to be made at specified points and enables them subsequently to be readily located in the microscope field.

(4) The small loads are less likely to cause the diamond to shift in its mounting (usually monel metal) when measurements are made at very high temperatures.

Procedure for Making Measurements

After the specimens have been placed in the instru-

ment, the apparatus is evacuated and then flushed with hydrogen. Nitrogen or argon can also be used. Before the current to the furnace is turned on, the atmosphere in the apparatus is tested by heating a strip of bright steel which is located within a transparent silica tube inserted in the gas line leading to the furnace. If the steel remains bright after being heated and cooled, the tester is heated.

The furnace heats rapidly; about 10 minutes are required to reach a temperature of 600° C (1112° F), and in about 25 minutes a temperature of 800° C (1472° F) is attained. The furnace is held at any one temperature for about 15 minutes before indentations are made. At each temperature a set of three indentations about 0.01 inch (0.25 mm) apart are made according to pre-selected micrometer settings. A molybdenum sample is included in each set of specimens to check the precision of the run. The apparatus has been used at 900° C (1652° F), but most of the data were obtained at a maximum temperature of 800° C (1472° F).

The accuracy of the hot-hardness tester could be determined only at room temperature. This was done by comparison with a standard type of microhardness tester. Measurements were made with the hot-hardness tester on a variety of specimens which were then measured with an Eberbach microhardness tester. The agreement of the results, on an average, was within 4 per cent.

The reproducibility of the instrument was determined by measurements on a molybdenum specimen. In four runs at room temperature, 400, 600 and 800° C (762, 1112 and 1472° F), the average deviation from the mean hardness at each temperature was less than 4 per cent.

Measurements

Some of the data obtained with the hot-hardness tester, shown in Figs. 2, 3 and 4, are given to illustrate the use of the instrument, and are not presented as part of a systematic investigation of the hot hardness of metals. Fig 2 shows that soft chromium and hard chromium are about equally soft above 600° C (1112° F). At 800° C (1472° F) the hardness of both has dropped to about 100 Vickers in contrast to the high initial values of 600 and 1000 Vickers.

It will be noted that electrodeposited chromium and nickel become permanently softened as a result of the heat treatment, i. e., when they have cooled to room temperature their hardness is less than the initial value. Conversely, cobalt and cobalt alloys, Figs. 3 and 4, regain a large part of their initial hardness on cooling, or may even increase in hardness, provided that the maximum temperature has not been excessive.

The fact that the hardness of a metal after heat treatment equals or exceeds the original values is not evidence of good hot hardness. This is demonstrated particularly well by the data on the cobalt-phosphorus alloys[8], Fig. 3, which have a hardness of only

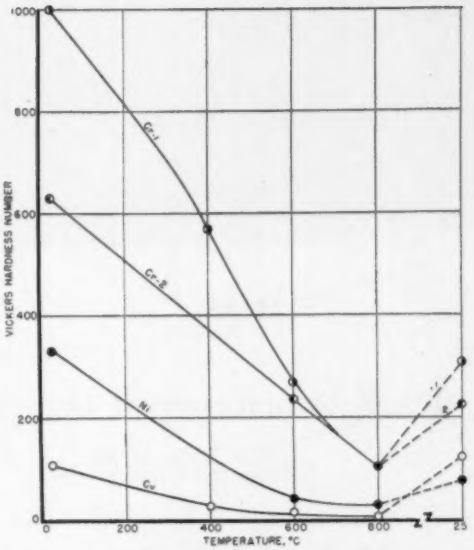

Fig. 2. Hot-hardness of chromium, nickel, and copper. Cr-1, ordinary bright chromium, deposited from bath containing CrO_3, 250 g/l; H_2SO_4, 2.5 g/l at 20 amp/dm², 50° C. Cr-2, soft chromium deposited from same bath as Cr-1 but at 85° C, 80 amp/dm². Ni, nickel deposited from an all-chloride bath, 238 g/l nickel chloride and 31 g/l boric acid at 5 amp/dm², 55° C. Cu, specimen prepared from a commercial bar of copper

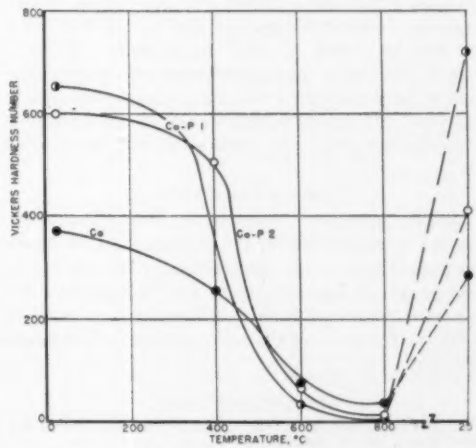

Fig. 3. Hot-hardness of cobalt and cobalt-phosphorus alloys. Co-P 1, cobalt-phosphorus alloy containing about 9 per cent of phosphorus. Co-P 2, cobalt-phosphorus containing about 1 per cent of phosphorus. Co, cobalt deposited from a cobalt chloride solution, 59 g/l cobalt

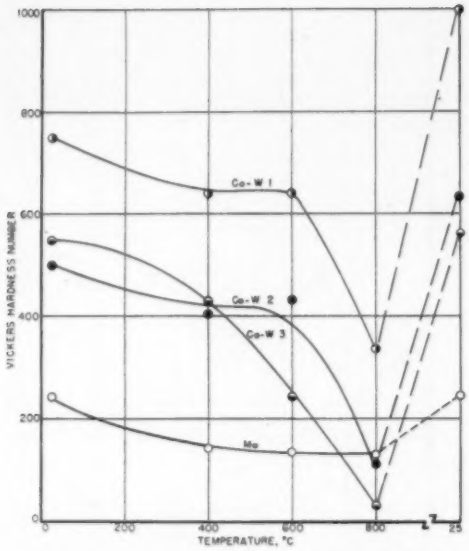

Fig. 4. Hot-hardness of cobalt-tungsten alloys and of molybdenum. Co-W 1, cobalt-tungsten alloy containing about 31 per cent of tungsten. Co-W 2, cobalt-tungsten alloy containing about 15 per cent of tungsten. Co-W 3, cobalt-tungsten alloy containing about 8 per cent of tungsten. Mo, commercial specimen of molybdenum bar

5 Vickers at 800° C (1472° F) but are harder than initially after cooling.

The hot hardness of the cobalt-tungsten alloys, Fig. 4, appears to increase with their tungsten content. The alloy containing 31 per cent of tungsten is outstanding in hot-hardness. At 800° C (1472° F) it is as hard as cobalt at room temperature. Unfortunately, the higher the tungsten content the more difficult is the deposition of the alloys, and the more likely they are to be excessively brittle and to crack on heating, especially when deposited on a steel basis metal.

ACKNOWLEDGMENT

Acknowledgment is made to M. Sullivan for assisting in the initial design of the instrument, to W. Grote for suggestions on the construction of the apparatus, and to several members of the Electrodeposition Section of the National Bureau of Standards who assisted in the construction of the tester and in making measurements.

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Book Review

DR. HAROLD J. READ
Associate Professor of Metallurgy, Pennsylvania State College

THE METALLIZATION OF PLASTICS by J. R. I. Hepburn, 71 pages, 1947. Cleaver-Hume Press, Ltd., 42a S. Audley Street W. 1, London, England; Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y.

The introduction to this little book contains an admirable statement of the problems involved in the metallization of plastics, and the subsequent chapters are devoted to descriptions of the practical operations.

The discussion of metallization from solutions is satisfactory insofar as surface preparation and the deposition of a conducting film are concerned, but the recommendations for electroplating are hopelessly antiquated. The formula for a Rochelle-copper bath is ancient, and the recommended nickel-plating processes have long been abandoned by progressive platers.

The three main types of metal-spraying pistols, namely, wire, powder and molten metal, are described and compared. In spite of the fact that the comparisons are based on British prototypes, they should be of interest inasmuch as there are few fundamental differences in the pistols of each type as developed by various manufacturers.

Cathode sputtering and vacuum evaporation are becoming increasingly important as metallization techniques. The author has recognized this fact, and discusses both methods in some detail. There are schematic drawings which illustrate the basic principles involved in the design of sputtering or evaporation equipment, but very little is said about the modifications which are necessary for mass production. The advantages and limitations of the processes appear in the course of the discussion although they are not set forth explicitly. Inasmuch as the equipment for the production of the vacua required in both sputtering and evaporation techniques is not commonly used by workers in the metal-finishing field, a short discussion of this apparatus would be a desirable addition.

The concluding chapter contains remarks on the nature of the formation of deposits as applied by the several methods and on their characteristic properties, but the emphasis is on sprayed coatings. Tests for adhesion, thickness, porosity, hardness and electrical conductivity are described very briefly, and working directions are given on only a few instances.

There is a short bibliography at the end of each chapter, and the citations are keyed to the text. The references are not especially well chosen, this being particularly true for electrodeposition.

The book will be of most interest to the reader who is unfamiliar with the subject and wishes to acquire a general knowledge of its main aspects with a minimum of reading.

project no. 12

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Acknowledgment is due the Research Committee, Mr. William M. Tucker, Eastman Kodak Company, Chairman; the Research Directing Committee, Mr. B. C. Case, Hanson-Van Winkle-Munning Company, and Mr. G. M. Cole, Ternstedt Division, General Motors Corporation, Chairman and Vice-Chairman, respectively; and the Project Committee, Dr. Herbert Bandes, Sylvania Electric Products, Inc., Chairman; Dr. Donald Price, Oakite Products, Inc.; and Dr. Edward Parker, Technic, Inc., for their contributions to this project.

*AUTHORS

APRIL, 1951

Cleaning and Preparation of Metals for Electroplating

II. SOILING AND CLEANING PROCEDURES*

SUMMARY

The nature of the problem of soiling and cleaning metals in the laboratory is reviewed. The cleaners, soils, and metals to be used are presented. The shape and size of panels used and the equipment necessary for the preparation of the samples are discussed. A standardized process for pre-cleaning, soiling, and cleaning panels prior to testing is offered. Gravimetric data on the amount of soil present under standard conditions are given, and the effect of several operating variables is presented and analyzed.

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OBJECT

The purpose of this phase of the research is to decide upon what metals, soils, and cleaners will be used in this project, and to develop a satisfactory method for reproducibly soiling and cleaning the test panels.

1. INTRODUCTION: A REVIEW OF SOILING AND CLEANING PROCEDURES

(a) *Metals*

It has been previously pointed out that the primary purpose of the project is to

*This report is based on laboratory work conducted during the period December, 1949–April, 1950.

study cleaning evaluation techniques, rather than to study the performance of any particular cleaner in removing any soil in question. This being the case, it is not necessary to work with many different metals, as most of the cleanliness tests, such as those dependent upon contact-angle phenomena, fluorescence of oil, and gravimetric determinations, will behave in the same manner irrespective of the basis metal chosen. The metal to be chosen should be readily available, industrially common, and typical of metals previously used in laboratory investigations of metal cleaning. The metal chosen for use in this project is cold-rolled SAE 1010 steel. (See Appendix (a) for specifications.) This metal has been commonly used in studies of this type[71,133,139,160,167].

(b) *Soils*

For the sake of simplicity and reproducibility, the soils selected in the early phase of a project such as this should not be heterogeneous, complex soils of rather uncertain specification. The soils used should be readily available, simple, of relatively rigid specifications (so that the source of the soil is unimportant), and typical of the soils encountered industrially.

In the "Critical Survey of the Literature", soils were discussed under two general headings: "Inorganic Soils", and "Organic Soils". As it is the latter soils which solvent, solvent-emulsion, and alkaline soak and electrolytic cleaners are primarily designed to remove, it is these soils which will be investigated. A typical mineral oil and a typical fatty oil will be used at the start of this project. (See Appendix (b) for specifications.) These oils are typical of those used in much previous laboratory work in this field[71,160,167]. Various cutting and motor oils have been used in investigations of this kind[69,71,73,133,167], and in this project a number of these were used briefly. (See Appendix (b) for specifications.) Their use was discontinued, however, because their compositions vary from sample to sample. For instance, the additives used in a motor oil not only vary from one manufacturer to the next but will vary even between two samples of the same manufacturer's product. This, therefore, renders such oils unsuitable for the primary phases of this research project.

(c) *Soiling Procedures*

Four general methods of soiling panels have appeared in the literature. In one method, the panels are dipped into the soil, and then allowed to drain in air under specified conditions[71,160,167]. In another commonly used method, pieces of flannel which have been soaked in the soil are placed between alternate layers of samples[71,132,139]. A pressure of 500 psi (35 kg/cm^2) is applied to such a stack of panels, and the excess oil squeezed out is removed with absorbent cotton. The oil-soaked flannel method suffers from two drawbacks: (a) it is a comparatively complicated technique, which adversely affects reproducibility and (b) it has been shown to lead to a rather irregular distribution of oil on the panel surface. In a third method, a glass rod dipped in soil is passed over the panel surface[73]. This last-named method has been rejected for use in this project because its suitability is limited to the application of relatively small amounts of soil. A fourth method is to apply heterogeneous soils typical of cold-rolling, buffing and polishing-produced soils. Such a method usually involves the use of pressure and heat in its application[71], and is hardly suitable for use at the start of the project. Therefore, the method to be used in this project is the "dipping-and-draining" technique. The principal drawbacks to this method are two: (a) surface condition of the panel affects the amount of soil adhering and (b) irregularities in drainage occur because of temperature variation and because of the tendency for relatively heavy layers of oil to collect at the bottom of the panel. The manner in which these drawbacks have been minimized in this project will be discussed below in the sections on equipment and procedure.

(d) *Cleaners*

Again, since it is the testing of cleanliness and not the performance of cleaners which is being investigated, it is not necessary to use a wide variety of cleaners. An industrial survey was conducted[4], and a formulation typical of representative alkaline cleaners for steel was prepared for use in this project. The cleaner is:

Sodium o-silicate, Na_4SiO_4	85% by wt
Soda ash, Na_2CO_3	10% by wt
Wetting agent, Nacconol-NR	5% by wt
Concentration	6 oz/gal (45 g/l)

The temperature at which the cleaner is used and the time of immersion are the variables to be utilized to obtain panels cleaned to various degrees, ranging from complete oil coverage to complete oil removal.

The sodium o-silicate is obtained as a technical-grade product. The water of hydration varies and should be determined. For one manufacturer's product, the water content was found to be 28.4 per cent (by wt, wet basis), $\sigma = 2.2$, $n = 4$, which corresponds closely to the tetrahydrate. The product should be white, in powder, pellet, or flake form, and nearly odorless. On dissolution in water, the resulting solution should be virtually clear. As sodium silicates are the salts of a strong base and a weak acid, hydrolysis occurs. Only ortho-silicic acid is completely soluble. Meta- and tri-silicic acids are partially soluble, and the di-silicic acid is nearly insoluble.

The soda ash is obtained as cp-grade anhydrous sodium carbonate powder.

The wetting agent used is an anionic, aryl-alkyl sodium sulfonate type detergent. The product used for most tests is Nacconol-NR.

In the preparation of this cleaner, the soda ash and wetting agent are weighed out and dissolved in distilled water. The resulting solution is barely turbid, and has only slight foaming tendencies. The silicate is then weighed out and gradually added to the solution with agitation. The cleaner becomes very turbid and foams readily. If the wetting agent is added last, it is more difficult to avoid formation of curds and to get a uniform colloidal suspension of the detergent. Finally, water is added to form one liter of solution, which is capped and stored until needed. In general, the cleaner is prepared no more than 1½–2 hours before use. When needed, the solution is brought to the desired temperature immediately before use.

(e) *Cleaning Procedures*

As solvent and solvent-emulsion cleaners are not suitable for the final treatment in oil removal prior to plating, only alkaline cleaning need be considered in this project. Either a soak or electrolytic operation may be employed. For the sake of simplicity and reproducibility, and in accord with most previous work in the field[69,71,73,111,133,139,133,160,167], a soak operation will be used.

2. Presentation of Data

The results of the work in a project of this type must be analyzed statistically. This is necessary because the results obtained on any one panel are relatively meaningless, and significant results can be had only by analyzing large numbers of panels. Three statistical criteria will be employed in presenting the results: standard deviation, t test, and limits of confidence.

(a) *Standard Deviation* (σ)

The standard deviation gives a measure of the reliability of the arithmetic mean of any given series of experimental results if the experimental conditions are under adequate control. At least 75 per cent of the total number of observations in any such series of results lies within the range $\bar{X} \pm 2\sigma$, while *all* lie within the range $\bar{X} \pm \sqrt{n}\sigma$, where n is the number of observations.

(b) *t Test* (t)

The t test is a measure of the probability that the means of two sets of observations actually represent different values. If the value of t is higher than the value of t given in the t table, then it is certain that the two sets of observa-

tions differ, with the degree of certainty chosen. The value of t varies with the level of significance and the number of degrees of freedom. The level of significance indicates the certainty with which the answer is given. Thus, if an answer is given at the 0.10 level of significance, it means that there are at least nine chances out of ten that the given answer is correct; at the 0.01 level of significance, there are at least ninety-nine chances out of one hundred that the given answer is correct, etc. The degrees of freedom in this work is $n_1 + n_2 - 2$, where n is the number of observations in any given series. For example, if the means of two sets of observations differ, where the number of degrees of freedom is 13 and the value of t is 3.0, reference to a t table (see Appendix (d)) shows that this value of t corresponds to a level of significance of 0.01, i. e., one can be 99 per cent certain that the two means actually represent different values. Had t been larger, one would have been more certain of the existence of a difference. Had t been smaller, one would have been less certain.

(c) *Limits of Confidence* (L)

The L test is a measure of the certainty that the difference of the means of two sets of observations has the value indicated. The value of L is a function of the level of significance. Thus, if the difference of two means is 3.00; $L = \pm 0.50$ at the 0.10 level of significance, it means that one can be 90 per cent certain that the true value of the difference between the two means is between 2.50 and 3.50.

3. Equipment

(a) *Sample*

The shape of the samples used is shown in Fig. 1. All cutting operations are performed with a Di-Acro notcher to minimize any irregularities in drainage which might occur because of burred edges. Cleaning results will be evaluated for the central 2 x 3-inch (51 x 76-mm) section of the panel. The addition of the triangular bottom section permits elimination of irregularities in results of cleaning tests due to the drop which collects at the tip of the panel during drainage. The tongue at the top of the sample permits the panel to be clamped rigidly without any of the connecting rods coming into contact with the various baths. The S-bend in the tongue insures that corrosion products and other substances will not drain down the main body of the sample and thereby invalidate cleaning-evaluation test results. In operation, the samples are placed in the various solutions to a depth sufficient to cover the S-bend completely, except in the oil dip, where the samples are immersed such that the top of the central 2 x 3-inch (51 x 76-mm) section of the panel is barely immersed.

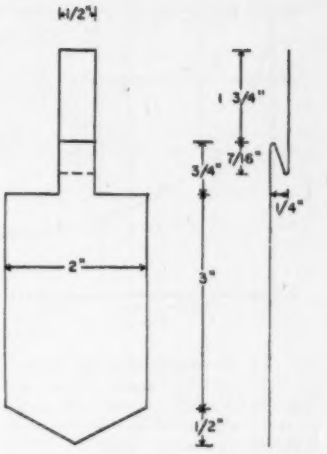


Fig. 1. Shape of sample

TABLE I. SOILING AND CLEANING PROCEDURE

Process	Operation	Temp, °C	Time, min
(a) Pre-Cleaning	Waste cleaner	100	15 soak
			3 overflow
	Water Rinse	Room	3 soak
			2 overflow
(b) Pickling	20% HCl Dip	Room	2
	Water Rinse	Room	2
(c) Solvent Treatment	CH_3OH Dip	Room	2
	C_6H_6 Dip	Room	2
(d) Soiling	Oil Dip	Room	5
	Drainage in Air	Room	20
(e) Cleaning	Alkaline Cleaner	Variable	Variable soak
			3 overflow
	Water Rinse	Room	3 soak
			2 overflow
(f) Preparation for Testing	1% HCl Dip	Room	1
	Water Rinse	Room	2 overflow

(b) *Sample holder*

A sample holder has been designed to insure rigid support of the samples as they are transferred from one bath to the next. At the same time, it prevents the panels from coming into contact with any solid objects, such as drying racks, which might influence cleaning-evaluation results.

The sample holder consists of a plywood board into which three holes have been drilled. Copper rods pass through the holes and are clamped rigidly in place. Brass connectors are placed at the end of the copper rods, and the panels are attached to the connectors. Three samples are processed simultaneously in all operations. During cleaning and soiling runs, the three panels are hung vertically, at right angles to one another. During testing, the three panels are hung side by side, all facing in the same direction. During the pre-soiling, soiling, and cleaning operations, the holder is kept in a horizontal position by a clamp attached to a ring stand.

(c) *Cleaning bath*

The cleaning container is a one-quart (950-ml) steel can of 4-inch (100-mm) ID. It is provided with a 5/8-inch (16-mm) ID spigot soldered on just below the lip. A 7-mm diameter glass tube enters the container from a two-liter bottle, located above the cleaning bath and equipped with a siphon arrangement. This tube projects to the bottom of the

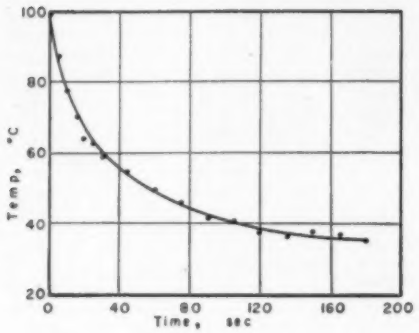


Fig. 2. Temperature of solution at point of overflow during alkaline-cleaner run-off and soak periods

can. The cleaning solution fills the can up to the overflow spigot. When the siphon is operating, solution overflows at the rate of about 1 l/90 sec. The container is heated by a Bunsen burner.

(d) *Other baths*

The acid pickle, acid dip, alcohol dip, and benzene dip containers consist of one-liter beakers. The oil container is a 500-ml beaker. The water rinse container is identical with the cleaning can mentioned above except that the interior is lacquered.

4. Procedure

Table I summarizes the pre-cleaning, soiling, and cleaning procedure. The details of the various steps follow:

(a) *Pre-cleaning*

1. *Alkaline waste cleaner.*—Samples are placed in boiling (100.5–101° C) alkaline waste cleaner for 15 min. The source of the waste cleaner is indicated below under (e) 2.

2. *Alkaline run-off.*—Distilled water at room temperature enters the cleaning tank at the bottom at the rate of about 1 l/90 sec for a period of 2 min 15 sec. To assist in removing suds sticking to the wall of the can and to the tongues of the samples, distilled water from a wash bottle is directed at the suds on the solution surface.

3. *Alkaline soak.*—The panels are then allowed to remain in the cleaning can an additional 45 sec. The purpose of this is to permit overflow to cease. If the surface of the solution is not quiescent, oil has a tendency to de-emulsify and skim across the surface. At the end of this period, the samples are removed, passing through a clean solution surface containing virtually no oil slick which could cause recontamination of the panels.

4. *Water soak.*—While still wet, the panels are placed in a can of distilled water at room temperature for 3 min.

5. *Water run-off.*—Distilled water from the overhead tank flows in for 2 min, at the end of which the flow is stopped, and the panels are removed.

A study of temperature changes during the alkaline run-off and alkaline soak operations discussed under (a)2–3 is shown in Fig. 2. An examination of the *p*H of the solutions during alkaline run-off and water rinsing steps in (a)2–5 was made with Hydrion papers. At the end of the alkaline run-off and alkaline soak periods, the *p*H of the solution is still in excess of 11. The distilled water has a *p*H of about 5.5 initially, but this rises to about 6–7 during the 3-min water-soak period because of the alkaline film on the samples. After the 2-min water run-off period, the *p*H has returned to about 5.5.

(b) *Pickling*

1. *Acid Pickle.*—The samples are then pickled in 20% HCl by wt at room temperature for 2 min. Fairly vigorous gassing occurs. At the end of the pickling period, the samples are removed and shaken slightly. Inhibited acid was also tried, and found to be less satisfactory as it led to the formation of difficultly removable inhibitor films.

2. *Water dip.*—While still completely wet, the samples are dipped into distilled water for 2 min at room temperature. They are then removed and shaken slightly.

(c) *Solvent treatment*

1. *Alcohol dip.*—The panels, while still completely wet, are dipped into methyl alcohol for 2 min at room temperature. This suffices to remove the aqueous film, which dissolves in the alcohol. At the end of this period, the panels are removed and shaken slightly.

2. *Benzene dip.*—The panels, while still completely wet, are dipped into the benzene for 2 min at room temperature. This removes the alcohol film, which dissolves in the benzene. At the end of this period, the panels are removed and shaken slightly.

(d) *Soiling*

1. *Oil dip.*—The samples, while still completely wet, are dipped into the oil being used for soiling and mildly agitated. After 30 sec, the samples are removed from the oil. The oil should be adhering to the panel as a thin, completely uniform film. If not, the run must be rejected, as the chemicals are no longer fit for use. The panels are then reimmersed in the oil until a total period of 5 min has elapsed. The panels are then removed.

2. *Drainage.*—The panels are permitted to drain in a vertical position for 20 min at room temperature (27–29° C; 81–84° F). At the end of the drainage period, the drop hanging at the bottom is removed by touching the panels with a glass rod. Panels soiled in this manner show but little surface contamination prior to the oil dip, and only a slight amount of corrosion after 20 min of drainage.

(e) *Cleaning*

1. *Alkaline cleaner.*—The samples are placed in the alkaline cleaner, at any desired temperature and for any desired period of time.

2. *Alkaline run-off.*—The procedure is identical with (a)2. The material collected from the overflow through the spigot is stored, and serves as the waste alkaline cleaner to be used in step (a)1 of the subsequent run. Though diluted and contaminated with oil, it still has a *p*H of about 12.

To determine the reserve cleaning power of this waste cleaner, samples in the as-received condition were cleaned in this solution in the usual manner, the run-off collected, and this waste product reused as a waste cleaner for the next set of samples, etc., until the waste cleaner was unable to clean the samples, as determined by the waterbreak test. The results are shown in Table II.

In the normal course of events, the waste cleaner is not reused, because an unused waste cleaner from the previous

TABLE II. RESERVE CLEANING POWER OF WASTE CLEANER

Cleaner	Temp, °C	Time, min	Water Break
1. Original waste cleaner	100	3	No
2. First re-use	100	3	No
3. Second re-use	100	3	Yes
		5	No
4. Third re-use	100	15	Yes

run is always available at the start of each run.

3. *Alkaline soak.*—Identical with step (a)3.

4. *Water soak.*—Identical with step (a)4.

5. *Water run-off.*—Identical with step (a)5.

(f) *Preparation for Testing*

1. *Acid dip.*—The panels are immersed in 1% HCl for 1 min at room temperature. At the end of this period, the samples are removed and shaken slightly.

2. *Water run-off.*—The samples are returned to the water-rinse can and treated as in step (a)5.

3. The panels are removed, and are ready for testing. One feature of this process is that the panels are never permitted to dry at any time. However, this leads to carry-over of material from one bath to the next. As water is not very soluble in benzene, and neither water nor alcohol are too highly soluble in the oils used, it is apparent that in time immiscibility of solutions will occur at the panel surface. This would destroy the utility of the method. Thus, laboratory data were collected for the phase diagrams listed below in order to determine approximately how long the solvents could be expected to be useful, and whether immiscibility was more likely to arise first in one bath, then in another. From the phase diagrams, it was determined that immiscibility was not more likely to occur earlier in one bath than another. It was estimated that the solvents could be used up to 25–30 times in the case of lard oil, but no more than 15–20 times in the case of mineral oil. The following phase diagrams appear in Figs. 3 and 4.

Benzene-methyl alcohol-water (benzene-rich end)
Benzene-methyl alcohol-mineral oil (oil-rich end)
Benzene-methyl alcohol-lard oil (oil-rich end)
Benzene-methyl alcohol-mineral oil-water (oil-rich end)
Benzene-methyl alcohol-lard oil-water (oil-rich end)

5. Evaluation of Soiling Techniques

Gravimetric tests were made to determine the amount of soil on the test panels when various soiling techniques are used. The results of these tests are shown in Table III and in Fig. 5. The effect of several variables is discussed below. The results for the various procedures utilized have been compared with those for the standard procedure. *t* tests have been made to determine the probability of an actual difference between amounts of oil present per panel following any given procedure and that present following the standard procedure.

Limits of confidence (*L*) for the 0.05

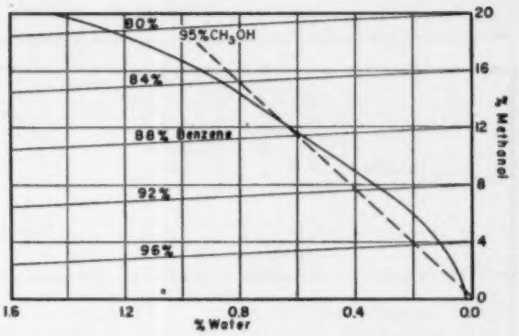


Fig. 3. Benzene-methyl alcohol-water system at 25 ± 0.5° C

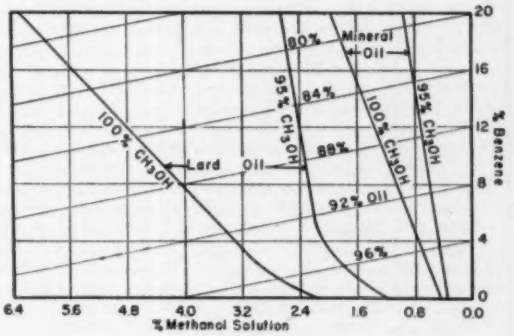
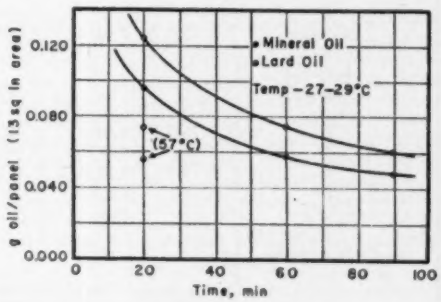


Fig. 4. Benzene-methyl alcohol-water-oil systems at 27–28° C



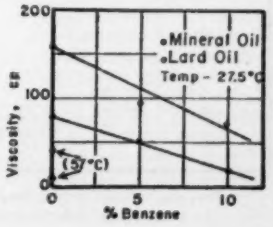


Fig. 5. Soiling characteristics. Top, effect of time and temperature of drainage upon amount of oil present. Bottom, effect of solvent concentration and temperature upon viscosity of oils

TABLE III. SOILING CHARACTERISTICS

Area of Soiled Panels—13 sq in.

Variable		Mean $\bar{X}$ g	Oil Film Thickness mm	σ g	σ %	n	Diff. of Means $\bar{X}-\bar{X}_{std}$ g	Deg. of Freedom for t Test	t	L $\pm$ g
Mineral Oil										
Standard		0.0966	0.0135	0.0014	1.5	8	.....	..	...	.....
Method of Preparation		Effect of Different Methods of Preparation*								
B		0.0914	0.0128	0.0028	3.0	8	0.0052	14	4.7	0.0024
C		0.0889	0.0124	0.0026	2.9	6	0.0077	12	7.2	0.0023
D		0.0857	0.0120	0.0048	5.6	6	0.0109	12	6.2	0.0038
E		0.0849	0.0119	0.0115	18.3	6	0.0117	12	2.9	0.0088
F		0.0915	0.0128	0.0122	13.4	6	0.0051	12	1.19	0.0093
% C_6H_6 in Oil	Condition of Solvents	Effect of Impurities†								
0	used	0.0929	0.0130	0.0031	3.4	4	0.0037	10	2.9	0.0028
10	pure	0.0951	0.0133	0.0026	2.7	4	0.0017	10	1.5	0.0025
10	used	0.0918	0.0128	0.0030	3.3	4	0.0048	10	3.9	0.0027
Time of Drainage min	Temp. of Drainage °C	Effect of Time and Temperature								
60	27–29	0.0588	0.00824	0.0015	2.5	7	0.0378	13	51.1	0.0016
90	27–29	0.0495	0.00694	0.00085	1.7	6	0.0471	12	74.0	0.0014
20	56–59	0.0570	0.00819	0.0041	7.2	4	0.0396	10	27.2	0.0032
Lard Oil										
Standard		0.1250	0.0165	0.0034	2.7	8	.....	..	...	.....
Method of Preparation		Effect of Different Methods of Preparation*								
B		0.1254	0.0166	0.0010	0.80	4	0.0004	10	0.2	0.0045
D		0.1192	0.0158	0.0070	5.9	4	0.0058	10	2.0	0.0065
E		0.1399	0.0184	0.0112	8.0	4	0.0149	10	3.6	0.0093
F		0.1651	0.0218	0.0216	13.1	4	0.0401	10	5.4	0.0166
% C_6H_6 in Oil	Condition of Solvents	Effects of Impurities†								
10	pure	0.1260	0.0166	0.0005	0.4	4	0.0010	10	0.6	0.0037
10	used	0.1250	0.0165	0.0041	3.3	4	0.0000	10	0.0	.....
Time of Drainage min	Temp. of Drainage °C	Effect of Time and Temperature								
60	27–29	0.0747	0.00985	0.0017	2.3	8	0.0503	14	37.6	0.0029
90	27–29	0.0612	0.00809	0.0015	2.4	6	0.0648	12	43.5	0.0033
20	56–59	0.0748	0.01020	0.0029	3.9	4	0.0502	10	25.2	0.0045

*See page 373 for description.

†See page 373 for definition of used solvent.

level of significance were determined for the difference of the means of gravimetric soiling tests made under various conditions with those made under standard conditions.

(a) *Effect of Different Methods of Preparation*

Samples were prepared in six different manners.

A. Standard.

B. Standard, except that the samples were allowed to dry after the benzene dip, permitting formation of thin oxide films.

C. After pickling, the samples are rinsed in distilled water and allowed to dry, causing rust formation on the panel surface.

D. Samples soiled in the "as-received" condition.

E. Samples soiled after the alcohol dip, while still completely wet with alcohol.

F. Same as method C, but soiled while still wet with water.

The effects of treatments B and C is to cause soiling to consist essentially of oil-oxide bonding. Method D eliminates all pre-soiling treatments. Methods E and F cause soiling to occur on surfaces containing liquids largely immiscible with oil.

The results of these tests show that metal-oil or oxide-oil bonds result in reproducible soiling conditions ($\sigma < 3$ per cent). Oil-oil bonds lead to fairly reproducible soiling, although, in the case of mineral oil, there appears to be a progressive change in oil bath characteristics during the course of use. Surfaces covered with alcohol or water upon being dipped into oil yield very poorly reproducible soiling results, as would be expected.

With respect to the actual amounts of soil present, the oxide-coated surfaces seem to show a slight reduction in total amount of mineral oil present as compared with samples prepared under "standard" conditions which have much smaller amounts of oxide on the surface. t data indicate that the difference in amount of soil present has a very high probability of being a real one. The actual value of the differences of the means, however, is not well established, as can be seen by the fact that the value of L, the confidence limit, is about 30–40 per cent of the value of the difference of the means. In the case of lard oil, no significant difference is observed, as can be seen from the t and L data.

Samples soiled without pre-treatment show larger reductions in the amount of soil retained. In the case of mineral oil, the t value obtained indicates a strong likelihood of the existence of a real difference in the means observed, though again, the relatively large value of L indicates that the absolute value of the difference in the means is not well established. In the case of lard oil, the t value corresponds to a level of significance between 0.05 and 0.10. However, the value of L is larger than the difference of the means, so that even the existence of a decrease in amount of oil present is only fairly well established.

TABLE IV. VISCOSITY OF SOILS

Variable		Mineral Oil		Lard Oil	
% C_6H_6 in oil	Temp. °C	$\bar{X}$ cp	n	$\bar{X}$ cp	n
0	27.5	76.0	6	157	6
5	27.5	50.9	6	95.6	6
10	27.5	18.7	6	72.5	6
0	57	8.5	6	49.9	6

With respect to alcohol- and water-wetted surfaces, two opposing factors vie for importance. On the one hand, the oil-immiscible compounds tend to stick to the surface and prevent soiling. Thus, after evaporation during drainage, dry, unsoiled areas remain. On the other hand, the oil has a tendency to displace the oil-immiscible liquid causing thickening and shrinkage of the film and globule formation. This is especially true in the case of lard oil. After soiling, the globules have a tendency to be oil-covered, stopping major evaporation loss, and oil piles up immediately above the globule due to a "damming" effect. Thus, the amount of soil present after 20 min of drainage tends to be abnormally high. This is particularly true in the case of lard oil.

Statistical analysis indicates that in the case of mineral oil the real existence of a difference in the means is at least indicated for alcohol-wetted surfaces, but that no conclusions may be drawn for water-wetted surfaces. On the other hand, the existence of a real difference in the means is shown with a high degree of probability in the case of lard oil. L values for mineral oil are on the same order as or even larger than the values for the difference of the means, emphasizing the impossibility of drawing any conclusions from the data as to real differences between results with these methods and with the standard procedure. For lard oil, L values are 40–60 per cent of the value of the difference of the means.

(b) *Effect of Impurities*

As has been pointed out previously, the alcohol, benzene, and oil baths become contaminated in time, due to carry-over from bath to bath. An alcohol solution and a benzene solution that had been rejected after a long period of use because of immiscibility were analyzed for solids, and upon evaporation found to contain the following amounts of solids (mainly iron chloride):

Methyl alcohol....0.27 g/l ($\sigma = 0.03$, $n = 3$)

Benzene.....0.12 g/l ($\sigma = 0.05$, $n = 3$)

When such solvents were used in conjunction with pure mineral oil, a 3.8 per cent reduction in the amount of soil present was noted, with no serious loss of reproducibility of results. The t value corresponds to a 0.02 level of significance. The very large value of L however (75 per cent of the value of the difference of the means) shows that the actual difference in amount of soil present is not well established at all.

Tests were also made in which pure solvents were used in conjuction with oils containing measured amounts of benzene as contaminant, to simulate oils after long periods of use. No loss of reproducibility was noted for either mineral or lard oil. With respect to the amount of soil present, t tests show that no significant change occurs for either oil.

The two aforesaid tests were combined, and samples were soiled in contaminated oil, following treatment in contaminated solvents. No loss of reproducibility of results was noted. In the case of lard oil, no significant effects of the amount of soil present were observed. In the case of mineral oil, a 5 per cent decline in soiling amount was found. The t test indicates that this difference is a real one. L, however, is about 55 per cent of the value of the difference of the means, so that the value of the decline in soiling amount is not well established.

Interpreting these results, one can see that contamination of solvents and oils is unimportant in the case of lard oil, but that such contamination may result in a roughly 5 per cent decrease in the amount of mineral oil present, with a very strong probability that the difference is a real one and not accidental.

(c) *Effect of Time and Temperature of Drainage*

As would be expected, the amount of soil present on the surface decreases markedly with increased time of drainage. Thus, after 90 min of drainage, the amount of oil on the surface is only about one-half the amount present after the standard 20-min drainage period. Increased temperature also greatly diminishes the amount of soil present after drainage. Both in the case of mineral oil and of lard oil, the amount of soil left after 20 min of drainage at 56–59° C (133–138° F) is about the same as that

left after 60 min of drainage at 27–29° C (81–84° F).

The length of time of drainage is seen to have no effect upon reproducibility of soiling. At the higher temperature tested, reproducibility was poorer than at room temperature, but this was probably due more to experimental difficulties with the constant-temperature chamber used than to any fundamental factor.

The t values are extremely large, as would be expected since there cannot be any doubt of the effect of time and temperature changes upon soiling characteristics. The confidence limits are seen to be quite small in comparison to the difference of the means.

(d) *Viscosities*

The viscosities of mineral and lard oils were measured as a function of temperature and of benzene content. The results are shown in Table IV. Whereas increasing temperature and increasing solvent concentration both markedly reduced viscosity, the soiling characteristics, as was pointed out above, were found to be quite different. One explanation would seem to be that when the viscosity of the oil is reduced by solvent addition the viscosity of the oil on the panel during the drainage period increases as the solvent evaporates, so that the viscosity of the thin (on the order of 0.01-mm) oil film left after 20 min is a function only of the temperature and not of the original solvent concentration of the oil bath. Thus, at a given temperature, the addition of solvent, while lowering viscosity, should not affect soiling characteristics. On the other hand, raising the temperature should lower the viscosity of the oil, even at the surface itself, so that the amount of soil should decline. This would fit the observed facts.

(e) *Summary*

Reproducible soiling can be achieved by use of the method presented in the previous section. Contamination of the baths will not affect lard oil soiling characteristics until immiscibility occurs between the various solutions. In the case of mineral oil, however, contamination decreases the amount of oil present by a few per cent, and so the solutions must be renewed more frequently. The presence of alcohol or water on the panel surface also reduces reproducibility markedly. Changes in temperature or time of drainage also markedly affect soiling conditions.

6. Bibliography

The references cited herein are found in Plating 38, 164-166 (1951).

Contribution No. 13 from the Chemical Engineering Department, Engineering Research Center, Columbia University, New York, N. Y.

7. Appendices

(a) *Steel Specifications*

SAE 1010 cold-rolled steel

Can makers' quality MRT-3 (Carnegie-Illinois)

Oiled, 107 gauge

C	0.05–.12%
Mn	0.25–.60%
S	0.05% max
P	0.020% max
Si	0.010% max
Cu	0.20% max
Ni, Cr, Mo, As	no amount specified

Rockwell Superficial Hardness—54–60

Thickness—0.01177 inch

The surface roughness of the steel was determined with a Brush Surface Analyzer*. The results are given in Table V.

(b) *Oil Specifications*

Mineral Oil—Light, white paraffin oil, USP (Eimer & Amend)

Lard Oil—Prime, winter-strained grease oil; free fatty acid, 2% max; cold test, 40–45° F; saponification value, 190–198; Iodine No., 68–72. (Armour; Pergament; Welch, Holme and Clark)

Cutting Oil No. 101—Sulfo-chlorinated petroleum cutting oil; S, 2.59%; Cl, 0.53%; petroleum oil, 94.2%; flash pt, 370° F; viscosity (100° F), 173 SUV; viscosity (210° F), 44 SUV. (Keystone)

Cutting Oil—Mineral-Lard cutting oil (Keystone)

SAE 10 Motor Oil (Gulf; Esso)

SAE 50 Motor Oil (Gulf; Esso)

(c) *Laboratory Procedures*

Gravimetric tests.—At the conclusion of the oil drainage period, the drop hanging at the tip of the sample is removed by touching with a glass rod. The sample is then removed from the holder, grasped by the upper part of the tongue, and held over a tared watch-glass. Anhydrous ether from a pipette is allowed to drain down the panel surface and fall onto the watch-glass. When all the removable oil is on the watch-glass, the asbestos-covered hot plate on which the watch-glass rests is turned on and the solvent evaporated. The watch-glass is placed in a desicator and allowed to cool. It is then weighed, and the weight rise taken as the amount of soil present. The panel is tested for completeness of oil removal by means of the water-break test.

Viscosity.—Viscosity readings were made with a K Exax Viscosimeter, size 300, temperatures and times being recorded with calibrated thermometers and stop-watches respectively. Calibration of the instrument was made by means of glycerine solutions. Water could not be used, because the capillary was so large that flow was turbulent.

Density.—Hydrometers were used to measure oil densities at various known temperatures.

(d) *Statistical Criteria*

All values are taken at the 0.05 level of significance.

t and L data were obtained by comparing the results of all runs with the "standard" run, i.e., the run in which the panels were prepared in the standard manner shown in section 4 of the report.

$$\sigma = \sqrt{\frac{\Sigma (X - \bar{X})^2}{n - 1}}$$

TABLE V. ROUGHNESS OF COLD-ROLLED STEEL

Specimen	RMS μin	σ	n	t_{1-2}	t_{2-3}	t_{1-3}	$t_{0.05}$
1	35	11	10	0.77	....	....	2.10
2	32	4	10	....	0.57	....	2.10
3	31	4	10	....	....	1.05	2.10
Av.	33	7	30	....	....	....	....

TABLE VI. t TABLE VALUES

Degrees of Freedom	Level of Significance				
	0.10	0.05	0.02	0.01	0.001
10	1.81	2.23	2.76	3.17	4.59
11	1.80	2.20	2.72	3.11	4.44
12	1.78	2.18	2.68	3.06	4.32
13	1.77	2.16	2.65	3.01	4.22
14	1.76	2.15	2.62	2.98	4.14

*The authors wish to express their deep appreciation to Dr. Louis Weisberg, 71 West 45th Street, New York, N. Y., whose generous assistance made possible the determination of the surface roughness of the steel used in this project.

$$s = \sqrt{\frac{\Sigma (X_1 - \bar{X}_1)^2 + \Sigma(X_2 - \bar{X}_2)^2}{n_1 + n_2 - 2}}$$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{s} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

$$L = \frac{(\bar{X}_1 - \bar{X}_2)\, t_{table}}{t}$$

t table values are shown in Table VI.

(e) *Laboratory Data*

The equivalent thickness of oil films shown in Table III in the report was obtained as follows:

$$\text{Thickness} = \frac{\text{wt soil}}{\rho a}$$

where a = 13 in²
weight readings in grams

Runs rejected because of irregularities in procedure are marked with an asterisk.

Standard Run

	Mineral Oil	Lard Oil
	0.0976	0.1243
	0.0973	0.1219
	0.0981	0.1274
	0.0977	0.1210
	0.0938	0.1311
	0.0962	0.1224
	0.0966	0.1270
	0.0957	0.1245
$\bar{X}$	0.0966	0.1270
σ	0.00140	0.00338
σ, %	1.5	2.7
n	8	8

Effect of Different Methods of Preparation

Mineral Oil

B	C	D	E	F
0.0918	0.0913	0.0903	0.0933	0.0891
0.0929	0.0866	0.0884	0.0539	0.0983
0.0942	0.0871	0.0868	0.0858	0.0819
0.0899	0.0909	0.0879	0.0939	0.0939
0.0888	0.0914	0.0840	0.0902	0.0758
0.0870	0.0859	0.0769	0.0925	0.1102
0.0953				
0.0912				
$\bar{X}$ 0.0914	0.0889	0.0857	0.0849	0.0915

Lard Oil

B	D	E	F
0.1247	0.1120	0.1484	0.1523
0.1258	0.1172	0.1256	0.1423
0.1243	0.1287	0.1492	0.1767
0.1266	0.1190	0.1363	0.1891
$\bar{X}$ 0.1254	0.1192	0.1399	0.1651

Effect of Impurities

Mineral Oil

Used Solvents	10% C_6H_6 in Oil	Used Solvents + 10% C_6H_6 in Oil
0.0887	0.0936	0.0915
0.0958	0.0855*	0.0961
0.0929	0.0962	0.0892
0.0943	0.0966	0.0903
	0.0939	
$\bar{X}$ 0.0929	0.0951	0.0918

Lard Oil

10% C_6H_6 in Oil	Used Solvents + 10% C_6H_6 in Oil
0.1263	0.1211
0.1260	0.1224
0.1264	0.1304
0.1252	0.1262
$\bar{X}$ 0.1260	0.1250

Effect of Time and Temperature

Mineral Oil

60 min	90 min	56–59° C
0.0574	0.0501	0.0538
0.0572	0.0504	0.0535
0.0609	0.0484	0.0617
0.0580	0.0500	0.0590
0.0584	0.0485	
0.0590	0.0496	
0.0606		
0.0650*		
$\bar{X}$ 0.0588	0.0495	0.0570

Lard Oil

60 min	90 min	56–59° C
0.0758	0.0606	0.0774
0.0767	0.0603	0.0768
0.0771	0.0604	0.0737
0.0743	0.0597	0.0711
0.0741	0.0634	
0.0721	0.0625	
0.0743		
0.0732		
$\bar{X}$ 0.0747	0.0612	0.0748

Viscosity: Oil Data

Mineral Oil

	0% C_6H_6 57 ± 1° C	0% C_6H_6 27.5° C	5% C_6H_6 27.5° C	10% C_6H_6 27.5° C
	54 (sec)	154	107	65
	53	152	109	64
	53	150	111	64
	52	151	111	65
	52	151	112	63
	51	152	113	64
$\bar{X}$	52.7	151.7	110.5	64.2
σ	1.1	1.4	2.2	0.8
ρ	0.831	0.851	0.850	0.850
η, cp	8.5	76.0	50.9	18.7

Lard Oil

	0% C_6H_6 57 ± 1° C	0% C_6H_6 27.5° C	5% C_6H_6 27.5° C	10% C_6H_6 27.5° C
	93	274	167	134
	93	278	175	137
	92	277	179	140
	94	279	181	144
	94	278	175	141
	93	280	182	141
$\bar{X}$	93.2	277.7	176.5	139.5
σ	0.8	2.2	5.5	3.5
ρ	0.879	0.904	0.902	0.899
η, cp	40.9	157	95.6	72.5

Densities

°C	75	70	65.	60
Mineral oil	0.822	0.824	0.826	0.829
Lard oil	0.871	0.873	0.875	0.877
°C	57	55	52	50
Mineral oil	0.831	0.832	0.834	0.836
Lard oil	0.879	0.880	0.883	0.884
°C	47	44	43	40
Mineral oil	0.838	0.840	.....	0.843
Lard oil	0.886	.....	0.889	.....
°C		38	33	27.5
Mineral oil		.....	.....	0.851
Lard oil		0.893	0.897	0.904

Viscosity: Glycerine Data

Glycerine, % by vol	100.0	95.0	86.36
Density, g/cc	1.255	1.237	1.217
Temperature, °C	29.2	29.0	28.9
Time, sec	862	411	205
	855	416	211
	866	419	216
		422	220
		423	219
		426	221
$\bar{X}$	861.0	419.5	215.0
σ	5.6	5.4	6.4

Standard glycerine viscosity data taken from M. L. Sheely, Ind. Eng. Chem. **24**, 1060 (1932).

From above tables and the equation:

$$\frac{\eta}{\rho} = A\,\Theta - \frac{B}{\Theta}$$

where Θ = time in sec
the viscosimeter constants were determined to be A = 0.642; B = 1241.

(f) *Nomenclature*

a—area of panel
cp—centipoises
L—confidence limit at the 0.05 level of significance
n—number of readings
s—standard deviation of two sets of samples
t—test of significance of the value of the mean, or of the difference in the value of the means of two sets of samples
t_{table} (.05)— the value of t for the 0.05 level of significance
X—weight of oil per panel in grams
$\bar{X}$—mean weight of oil per panel in a set of samples
η—viscosity in cp
ρ—density in g/cc
Σ—summation
σ—standard deviation of the mean for one set of samples
Θ—time

A. E. S. Buffalo Convention, July 30 – Aug. 2, 1951

Technical Sessions

After the Convention had been moved from Los Angeles to Buffalo, the Editorial Board has made certain changes in the technical program.

Dr. William Blum of the National Bureau of Standards will be the keynote speaker at the opening session on Monday morning, with the subject, "Research on Electrodeposition". "Some Engineering Aspects of Plating Room Operation" will be the topic for the Monday afternoon session.

On Tuesday morning there will be a symposium on "Finishing and Plating of Diecastings". Tuesday afternoon will be devoted to an open forum on "Substitute Finishes". Five qualified speakers will introduce different phases of the subject in short talks.

The Wednesday morning session will be devoted to "Plating Control", and the Thursday morning session to "A. E. S. Research".

Entertainment Features

The Host Branch has arranged a very excellent entertainment program, beginning with a "Gala Night of Food, Frolic and Fun", sponsored by the International Fellowship Club, on Monday night. The Annual Picnic will be held at the Automobile Club, Clarence, N. Y., with good food, prizes and surprises as the drawing cards. The Annual Banquet will be held as usual on Thursday night. Roast beef, dancing and gayety are promised.

Ladies' Program

Besides the general entertainment, the ladies meet for a Get-Acquainted, Renew-Acquaintance Luncheon on Monday noon.

On Tuesday they will travel to Niagara Falls for the Aunt Ella Society Luncheon sponsored by Oakite Products, Inc., with Dave X. Clarin as host, leading and only man. The International Fellowship Club has arranged a Ladies' Party on Thursday afternoon, which will end in good time for preparations for the Annual Banquet the same night.

The Convention Committee

Two changes have been made in the Buffalo Convention Committee. Dr. C. J. Wernlund has relinquished a General Co-chairmanship to become Educational Chairman in place of Stanley Bush, who now fills the post of Finance Chairman.

Hotel Reservations

An Application for Housing Accommodations, reprinted herewith, will be sent to all members of the A. E. S. and other interested persons. With it goes a copy of the tentative program.

Early reservations are suggested.

APPLICATION FOR HOUSING ACCOMMODATIONS

Annual Convention—American Electroplaters' Society—
Buffalo, July 30-August 2, 1951

Mrs. Mary E. Brock, Manager Housing Bureau
602 Genesee Building
Buffalo 2, New York

Please make Hotel Reservations as shown below:

HOTEL..... First Choice
HOTEL..... Second Choice
HOTEL..... Third Choice

If the hotels of your choice are unable to accept your reservations the Housing Bureau will make as good a reservation as possible elsewhere.

Number of Room(s) with Bath....*Double Room(s).....Rate Preferred $.....
....Twin Bedded Room(s)....Rate Preferred $.....
....Single Room(s).....Rate Preferred $.....

Arriving July..... Approx.....a.m.....p.m. Leaving August.....

Checkout hour 6:00 p. m.

*A "Double Room" contains only one bed, for occupancy by two persons.

The Name of Each Hotel Guest Must Be Listed

Please print the names of both persons for each double room or twin bedded room requested. Also names of all persons for whom you are requesting reservations and who will occupy the rooms asked for; *otherwise application will be returned.*

.....
.....
.....

Applicant..... Street Address.....

City.....Zone..... State.....

Hotel Rates in Buffalo

Hotel	*Single*	*Double*	*Twin*	*Suites*
Buffalo—Washington and Swan Sts.	$3.50 – 5.00	$6.00 – 8.00	$7.00 – 8.00	
Graystone—Johnson Pk. & Delaware	1.75 – 3.50	4.00 – 5.50	5.50 – 6.00	
Lafayette—Washington and Clinton	3.75 – 5.00	6.50 –10.00	7.00 –10.00	
Lenox—North near Delaware	4.50 – 5.00	7.00 – 7.50	7.50 – 8.50	
*Markeen—On Rt. 5, Main at Utica	2.75 – 4.50	5.75 – 8.50	5.75 –15.00	$16.00
Midtown—430 Delaware Avenue	3.00 – 5.00	5.00 –10.00	7.50 –10.00	
*Richford—210 Delaware Avenue	2.25 – 3.75	4.00 – 7.00	4.00 – 7.00	
Sheraton—715 Delaware Avenue	4.50 –10.00	4.85 – 6.75	7.65 –14.00	
Statler—Delaware Ave. at Niagara Square	4.50 – 7.50	8.00 –10.00	9.00 –14.00	14.00–24.00
Stuyvesant—245 Elmwood Avenue	5.00 – 8.00	7.50 –10.00	8.00 –14.00	
Touraine—274 Delaware Avenue	2.50 – 5.00	5.00 – 7.00	7.50	10.00–13.00
*Worth—200 Main Street	3.50	5.00	5.50	

*Some rooms available without bath

Review of the Month

SOAK CLEANING BEFORE ALKALINE ELECTROCLEANING

Soak cleaning is used to remove stamping and slushing oils, drawing compounds, buffing and polishing residue, and the shop dirt commonly found on metal articles prior to plating.

The soil is eliminated from the surface of a metal through five mechanisms:

1. Saponification of animal or vegetable oils to form soluble soaps (a slow reaction, usually of limited importance)
2. Emulsification, which breaks up oil and soil into very fine particles
3. Dispersion of the small particles throughout the solution
4. Flocculation, i.e., aggregation of solid dirt by certain alkaline silicates
5. Surface and interfacial tension effects, which result in a preferential wetting of the metal surface by the cleaning solution

These reactions take place in any well-formulated soak-cleaning solution. All are influenced by time of immersion, temperature, concentration, and agitation. With proper balance of the constituents comprising the cleaner, all reactions (except 1 in the absence of saponifiable oil or grease) take place at the same time and aid each other in the cleaning process.

By knowing the function of each common cleaner constituent the plater has a basis on which to judge the compounds presented to him for trial. Some of these functions are as follows:

1. Caustic soda aids the saponification of animal and vegetable oils.
2. Soda ash provides a reserve of alkalinity to neutralize acidic soils and keeps the cleaner compound dry and free flowing.
3. Silicates are of three main types: ortho-, sesqui-,

(Continued on page 378)

TABLE I. EFFECT OF CLEANER COMPOUNDING ON TIME OF SOIL REMOVAL BY SOAK CLEANING

Cleaner concentration: 6 oz/gal (45 g/l)
Cleaner temperature: 190° F (88° C)
Maximum cleaning time used: 15 min

Soil	Time for Soil Removal (in min) with Mixtures of				
	Caustic Silicate Phosphate Soda Ash	Caustic Silicate Wet. Ag.	Silicate Phosphate Soda Ash	Caustic Phosphate Soda Ash	Caustic Phosphate Soda Ash Wet. Ag.
Light drawing oil (SAE 30 mineral oil, 100° viscosity)	6	6	not clean	not clean	9
Medium drawing oil (SAE 40 mineral oil, 200° viscosity)	6	6	not clean	not clean	6
Slushing oil (mineral oil plus 15% fatty acid)		66	not clean	not clean	not clean
Liquid drawing compound (mineral oil plus 1% calcium soap)	9	not clean	not clean	not clean	15
Paste drawing compound (mineral oil plus 5% calcium soap)	9	not clean	not clean	not clean	not clean
Light-duty drawing soap (mineral oil plus 10% sodium soap)	3	6	3	not clean	not clean
Heavy-duty drawing soap (mineral oil plus 20% sodium soap)	3	9	3	not clean	not clean
Cutting oil (sulfur-base mineral oil)	6	not clean	not clean	not clean	not clean
Compounded rust-preventive oil	6	not clean	not clean	not clean	15

QUESTION BOX

readers' questions of general interest

Q. 112. What copper plate thickness is required to prevent carburizing in localized areas?

A. The thickness varies greatly with the carburizing conditions and the surface of the steel. A comprehensive study is found in an article by Sayers, "Copper Plating for Selective Carburizing", which appeared in the December, 1946, issue of THE MONTHLY REVIEW, predecessor of this journal.—K. G. SODERBERG.

Q. 113. My silver plate on pewter blisters after 1–2 weeks. I degrease, electroclean, scratch brush, electroclean, silver strike, silver plate for 5 minutes, scratch brush (without evidence of poor adhesion), finish silver plating, and polish. What is wrong?

A. I believe your trouble is in not using a copper strike. The following procedure has proved successful in our shop: (1) Soak clean for 3–5 min; (2) electroclean with direct current for 1–2 min in a 6 oz/gal mild alkaline cleaner similar to one used for diecastings; (3) pickle for ½–1 min in 10 per cent hydrochloric acid; (4) scratch brush; (5) copper strike for 1–2 min in Rochelle copper solution at reasonably high current density; (6) scratch brush and copper strike again if necessary; (7) blue dip for 1–2 sec in a solution of about 0.1 oz/gal mercury (as mercurous chloride) and 4–6 oz/gal sodium cyanide; (8) silver strike; (9) silver plate. Scratch brushing should not be necessary after silvering if previous steps have been taken properly. Scratch brushing should precede copper striking, and may be followed by quick soak cleaning (with agitation of the work) if desired.—F. K. SAVAGE.

Q. 114. What can be done to prevent gray spots on newly plated silver ware? They are a real nuisance in hot, humid weather.

A. The spots cannot be eliminated completely. Very thorough rinsing immediately after plating, including soaking in warm water for some time, will help.—F. K. SAVAGE.

A. Try the new water-displacing liquids immediately following plating and rinsing.—K. G. SODERBERG.

Review of the Month

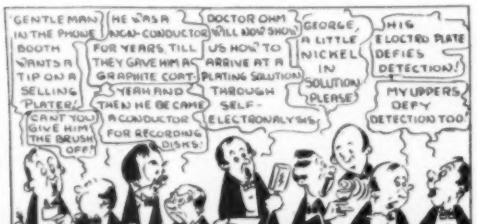
(Continued from page 377)

and meta-silicate. All act as flocculating and dispersing agents and provide active alkali for saponification and soil removal.

4. Polyphosphates remove water hardness by sequestering and peptize certain soils to aid in their removal from the metallic surface. Trisodium phosphate provides an alkaline reserve in the cleaning solution.
5. Soaps and wetting agents, although not related chemically, have similar effects on surface and interfacial tensions, and both aid in the emulsification of oils and other soils. Soap, in addition, because of its structure, adsorbs soil and removes it from metallic surfaces. The synthetic wetting agents, or surfactants, aid rinsing and contribute to the dispersion of soils already removed from the work.

A proper combination of these and other materials provides a soak cleaner which will remove most soils in a minimum time under the proper conditions of concentration and temperature. The work coming out of such a soak cleaner will be free of all visible dirt and films and have a surface free from water break. This surface is ready for subsequent processing. If the metal surface contains iron carbide, or "carbon", smut, soak cleaning is usually followed by electrocleaning to insure a satisfactory deposit.

The accompanying Table I lists some common soils found on metallic surfaces and the time required to obtain a surface free from water break by means of various combinations of the cleaner chemicals listed above. It shows the superiority of a balanced cleaner in removing a wide range of soils.


GENTLEMAN IN THE PHONE BOOTH WANTS A TIP ON A SELLING PLATER. CAN'T YOU GIVE HIM THE BRUSH OFF?
HE WAS A RAIL-CONDUCTOR FOR YEARS TILL THEY GAVE HIM AC GRAPHITE CORP. YEAH AND THEN HE BECAME A CONDUCTOR FOR RECORDING DISKS.
DOCTOR OHM WILL NOW SHOW US HOW TO ARRIVE AT A PLATING SOLUTION THROUGH SELF-ELECTRONALYSIS!
GEORGE, A LITTLE NICKEL IN SOLUTION PLEASE!
HIS ELECTRO PLATE DEFIES DETECTION!
MY UPPERS DEFY DETECTION TOO!
BOTTLE OF BEER
ALTERATION SALAD
JUICE
CHICKEN JELLY

NEWS ITEM - ELECTROPLATERS TO HEAR TALK ON CHROMIUM PLATING

This is the cartoonist Lon Mortison's impression of the Waterbury Branch January meeting. The cartoon was published in the Waterbury Republican and the Waterbury American, and sent us by the Branch Secretary, S. L. Henn.

LASALCO'S

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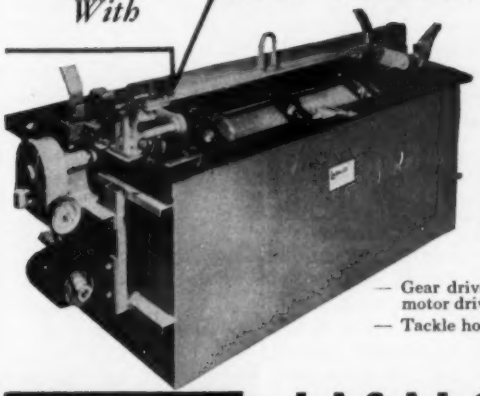

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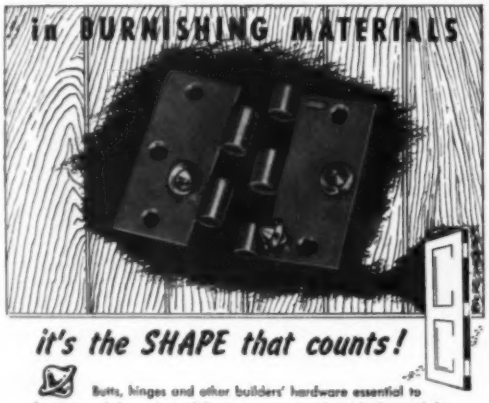

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Article Abstracts

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Anodic Oxidation Finishes for Aluminum and Aluminum Alloys. Brit. Standards Inst., Brit. Standard 1615 (1949) 23 pp.; Chem. Abs. 44, 5232 June 25, 1950).

The Standard specifies the thickness of anodic coatings, reflection factors, resistance to abrasion, and fastness to light, and gives detailed descriptions of methods of measurement. Work is proceeding on corrosion-resistance specification.

Vinyl Finishes for Aluminum Alloys. W. A. Edwards. Light Metals **13**, 336–339 (June, 1950).

This article describes the results of tests on a new type of stoving lacquer of superior mechanical and surface-protecting properties. Ease and economy of application are outstanding.

Cyclic Phenomena Observed in Electropolishing of Silver. Howard T. Frances and William H. Colner. J. Electrochem. Soc. **97**, 237–240 (August, 1950).

A study was made of the anodic electropolishing of silver in a standard cyanide plating bath. The current flowing in such a cell shows repeating fluctuations under certain circumstances. Frequency of this cyclic effect is due to the anodic portion of the cell and is markedly dependent on the stability of the d-c source used. Best polishing is obtained at the highest frequencies.

Electrolytic Hexagonal Nickel. Ling Yang. J. Electrochem. Soc. **97**, 241–244 (August, 1950).

Conditions governing formation of the above in baths containing $NiCl_2$, $NiSO_4$, and H_3BO_3 were investigated. A mixed structure of face-centered-cubic and hexagonal-close-packed forms was always present in deposits made from baths containing a relatively large amount of $NiCl_2.6H_2O$ at higher current densities and lower bath temperatures. Deposits with a

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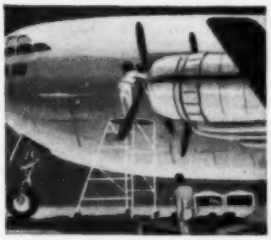

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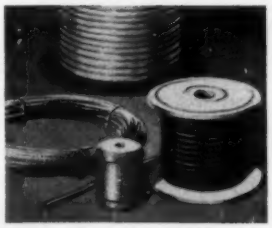

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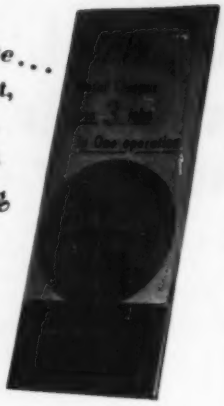

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Article Abstracts

mixed structure were found to contain more occluded hydrogen than those with a simple face-centered-cubic structure. The possible connection between higher hydrogen content and presence of the mixed structure under certain bath conditions is discussed. 13 ref.

Health Hazards in Metal Degreasing. Paul W. McDaniel. Metal Progress **58**, 77–78, 102, 104, 106, 108-109, 111 (July, 1950).

Surveys health hazards in alkaline, acid, and solvent cleaning.

Electropolishing of Carbon and Alloy Steels and Its Commercial Application. W. Eilender, R. Mintrop, and R. Au. Metalloberflache **2**, Sec. B, 81–88 (June, 1950).

Discusses the principles of electropolishing and reviews the literature. Conditions for the successful polishing of steels are enumerated; an automatic apparatus for polishing small articles is described and illustrated. Special polishing jobs and conditions are discussed. Illustrated. 39 ref.

Electroforming. Anon. Product Engineering **21**, 145–147 (August, 1950).

Describes and illustrates recent improvements which have put the process on a mass-production basis. Tubular and cup-shaped parts having special contours otherwise impractical to form can now be produced in quantity. Metallic coating of plastics, forming of precision dies, joining of small components, and production of limited quantities of parts for product development are other applications.

Evaluation of Organic Coatings by Electrographic Printing. Max Kronstein, Marion M. Ward, and Robert Roper. Ind. Eng. Chem. **42**, 1567–1572 (August, 1950).

Application of the electrographic-printing method for the detection of permeability of organic coatings and underfilm spreading of moisture gives new means for

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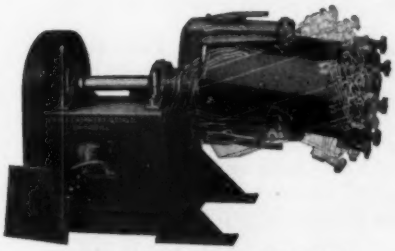

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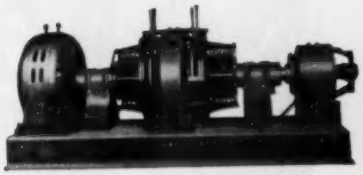

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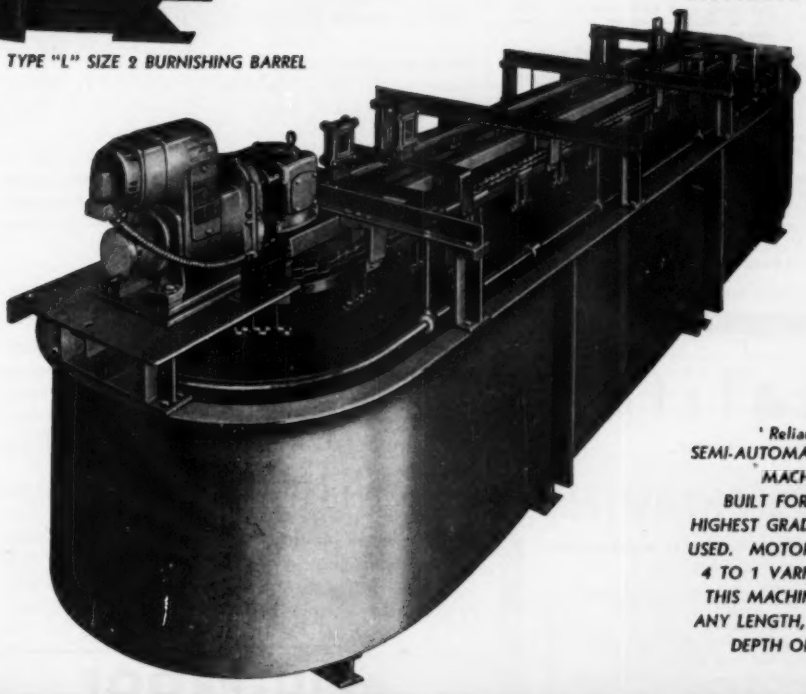

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the rapid evaluation of these coatings under many conditions and in conjunction with many of the usual test methods. The method has been used successfully over a period of nearly three years in the development and evaluation of new coatings and modifications of commercial coatings. The work reported is concerned with new applications of the method. Diagrams and illustrations.

Drag-Out Losses in Wire Plating. Parts II-III. Joseph B. Kushner. Wire and Wire Products **25**, 646–648, 695–697 (August, 1950).
Gives recommendations for reduction of losses, then describes use of recovery rinse tanks to recover material carried out of the plating tank. Presents mathematical analysis of the process and shows how the equations can be applied to practical problems.

Electrodeposition of High-Tin Bronzes. N. P. Fedot'ev, N. M. Vyacheslavov, and E. I. Orlova. Zhurnal Prikladnoi Khimii **23**, 380–385 (April, 1950).
Experimental investigation indicates that speculum plate may be obtained by using a stannate-cyanide bath of the following composition: tin 45–60; copper 10–15; NaOH, 25–30; and KCN, 10–15 g/l. Optimum electrical conditions were also determined. Data are charted and tabulated.

Engine Wear. Harold Myers. SAE Journal **58**, 46–49 (August, 1950).
Summarizes proceedings of 1950 SAE Summer Meeting round-table discussion. Relative merits of materials in terms of test and service-backed data were argued, including chromium plate for bearings and piston rings. Ring and piston failures were described.

Surface Finish Control. C. R. Lewis, Product Eng. **21**, 91–95 (August, 1950).
Makes realistic approach to the old problem of surface-finish specification, including a discussion of new SAE standards and of various effects below the surface of metals caused by different finishing operations.

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Consultant, New Britain, Conn.

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No. 2,534,911, December 19, 1950—Process of Removing Hydrogen Embrittlement of Bright Nickel Electrodeposits—A. S. Kasper, assignor to Houdaille-Hershey Corporation.

In accordance with the preferred process of the present invention, one surface or at least a portion of one surface of the nickel plated object is made chromium-free either by not coating that surface with chromium during the chromium plating operation or by stripping a portion of the chromium layer from the nickel deposit or basis metal (*e. g.*, by use of hydrochloric acid or other stripping agent or by abrasion). The deposition of chromium upon a nickel plated surface may be prevented during the chromium plating operation by means of a tightly fitting mask of suitable insulating material. Alternatively, a conductor in the form of a secondary cathode or "robber" may be employed to prevent deposition of chromium upon a portion of the nickel plated surface. The non-chromium plated area in the finished article may be sprayed with aluminum or other corrosion resistant material so that the exposed non-chromium plated area may be protected from corrosion.

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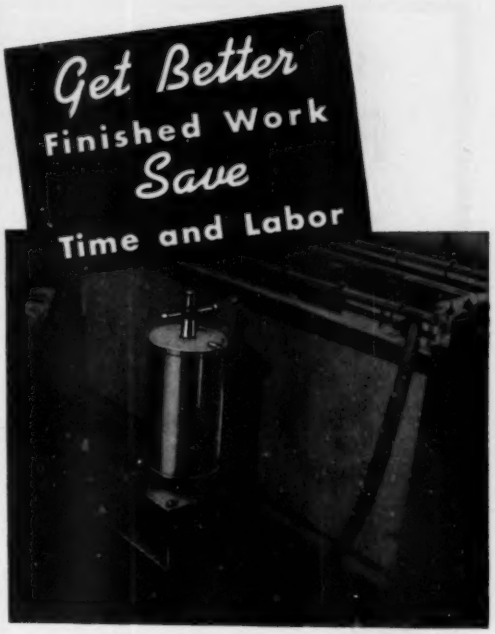

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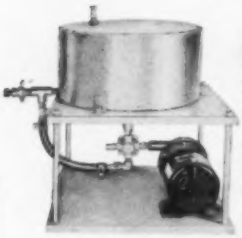

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Patent Abstracts

of the temperature, and in order to restore ductility within a reasonable time, I prefer to heat the deposit at temperatures of from 150 to 300 ° F for periods of time ranging from several hours to 15 minutes.

CLAIM 4. In the method of producing a ferrous foundation metal article having a ductile nickel plate and a chromium plate thereon by electrodeposition of a ductile bright nickel deposit from a bath containing nickel salts, coumarin and saccharin and electrodeposition of chromium on said nickel deposit, the steps which comprise stripping a portion of the chromium deposit from the plated article to expose a portion of said nickel surface and heating said article at a temperature of about 300° F to expel hydrogen through said exposed nickel surface whereby hydrogen embrittlement arising from said chromium electrodepositing step is relieved without thermally embrittling said electrodeposit for a period of time ranging from about 15 minutes to several hours.

5 claims.

References cited: U. S. Patents 154,435; 1,256,954; 1,792,082; 1,795,384; 1,838,273; 1,857,929; 1,863,868; 1,963,391; 2,270,316; 2,291,590; 2,321,182. Weiner (A. P. C.) Appl. Ser. No. 351,241, published May 18, 1943.

No. 2,535,035, December 26, 1950—Method of Electrolytic Water Softening and pH Adjustment—R. E. Briggs.

CLAIM 1. The method of softening hard water by treatment in the cathode compartment of a diaphragm electrolytic cell having a cathode positioned in the cathode compartment and an insoluble anode positioned in the anode compartment, which process comprises flowing said hard water as a catholyte through said cathode compartment in contact with said cathode, recirculating a separate anolyte through said anode compartment in contact with said anode, passing direct current between said anode and cathode whereby the *p*H of said anolyte decreases as the *p*H of said catholyte increases, discharging a portion of said an-

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24 VOLTS
2—1500 A. Century
1—2500 A. Gen. Elec.
2—3000 A. Electric Products

1— 600 A., 24 V. Reliance
1— 200 A., 25 V. Star
1— 300 A., 25 V. Star
1— 175 A., 25 V. Cr. Wh.

32 to 60 VOLTS
1— 500 A., 32 V. Columbia
2— 100 A., 30 V. Gen. Elec.
1— 200 A., 30 V. Wat.
2— 200 A., 32 V. Gen. Elec.
2—1500 A., 32/40 V. Century
1—1000 A., 33 V. Gen. Elec.
2—1000 A., 40 V. Chandeysson
2— 200 A., 42 V. Gen. Elec.
3—1500 A., 45 V. Century
1—1500 A., 50 V. Gen. Elec.
2— 800 A., 50 V. Gen. Elec.
1— 400 A., 50 V. Gen. Elec.
6—1500 A., 50 V. Century
1—1000 A., 60 V. Gen. Elec.

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Patent Abstracts

olyte to waste, adding make-up water to said anolyte and adding an alkaline material to said anolyte during said recirculation in addition to any seepage of catholyte through said diaphragm and sufficient to maintain the *p*H of said anolyte in said anode compartment above approximately 2, and subjecting said catholyte to treatment in said cathode compartment for sufficient time to cause precipitation of insoluble alkaline compounds of hardness-producing materials.

CLAIM 2. . . . in which alkaline compounds precipitated in said catholyte are employed as at least part of the alkaline material added to said anolyte.

CLAIM 3. . . . in which at least a part of the alkaline material added to said anolyte is calcium hydroxide.

3 claims, 3 figures.

References cited: U. S. Patents 1,371,698; 1,840,105; 2,341,356.

No. 2,535,966, December 26, 1950—Electrolytic Apparatus for Cleaning Strip—A. Teplitz.

CLAIM 1. Electrolytic cleaning apparatus comprising a vertical tank, a pair of conductor rolls over which a strip passes into and out of the tank, a sink roll at the bottom of the tank around which the strip passes, a chamber in the bottom of said tank leading upwardly from said chamber, said passageways forming the only outlets from said chamber, a pair of electrodes in each of said passageways, said strip passing downwardly between one of said pairs of electrodes and upwardly between the second of said pairs, means for introducing the electrolyte into the chamber and causing it to flow upwardly in each passageway, cascade plates above said chambers and adjacent said passageways over which the electrolyte flows after passing between the electrodes to release gases entrained therein, and means below said cascade plates for returning the electrolyte to the bottom of the tank.

4 claims, 2 figures.

References cited: U. S. Patents 1,210,663; 1,403,102; 1,625,484; 2,312,452; 2,317,242; 2,404,948; 2,431,948. British Patents 22,543; 11,842. Swiss Patent 24,338. German Patent 670,804.

USE READER SERVICE CARD; INDICATE A 322.
USE READER SERVICE CARD; INDICATE A 323.

No. 2,537,032, January 9, 1951—Acid Zinc Electroplating Compositions and Method—Allan E. Chester and Kurt J. Ackerman, assignors to Poor & Company, Ill.

. . . object is to provide a new and improved acid zinc plating bath which is capable of electrodepositing a milky-gray zinc plate with a high sheen over a wide range of current densities.

EXAMPLE. An electrolyte was prepared by mixing the following ingredients:

240 grams $ZnSO_4.7H_2O$
20 grams zinc gluconate
14.4 milligrams guanyl urea sulfate
3 cc acid fluoborate
Water sufficient to make one liter of solution
Current density up to 5000 amp/sq. ft.

CLAIM 11. A method of producing a ductile milky-gray deposit with a high sheen which comprises electrodepositing zinc from an acid bath comprising essentially zinc sulfate, zinc gluconate and guanyl urea sulfate at a *p*H within the range of 2.4 to 6.0 in a current density range of from 5 to 1000 amperes per square foot, the quantity of zinc gluconate being effective to exert a buffering action on the bath and the quantity of guanyl urea sulfate being effective to prevent black streaking.

13 claims.

References cited: U. S. Patents 2,384,300; 2,393,741; 2,461,809.

No. 2,538,242, January 16, 1951—Apparatus for Processing Workpieces—A. H. Hannon, assignor to Frederic B. Stevens, Inc.

The primary object of the present invention is to provide an improved method and apparatus especially adapted for processing small workpieces in bulk . . . which can be arranged in multiple with other similar units for an automatic plating cycle . . . in which the loading and unloading of barrels and similar containers is entirely eliminated . . . in which the entire surface of all the workpieces is exposed to the processing action.

CLAIM 2. In a processing machine, a tank for holding a processing liquid, a belt extending through the tank and around the tank and carrying work-agitating means on that portion of the belt normally in the tank, members on said belt normally positioned outside of said tank, reversible driving means for driving said belt to agitate workpieces thereon in the tank, means outside said tank actuated by said members for automatically reversing said driving means upon predetermined movement in either direction, and means selectively operable for biasing the direction of belt movement.

9 claims, 15 figures.

References cited: U. S. Patents 393,170; 545,429; 644,498; 854,626; 894,482; 1,034,219; 1,561,043; 1,852,144; 1,869,900; 1,885,602; 2,044,193; 2,074,599; 2,107,890; 2,302,626; 2,313,064. British Patent 19,828.

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A. E. S. News

Hartford Gets Files of A. E. S. Publications

The Hartford Public Library, chosen the Branch Library by the Hartford Branch, now has complete files of THE MONTHLY REVIEW and PLATING beginning 1927.

Most of the back numbers were contributed by Branch members, Emile and J. E. Beloin, Bill Cullen, Art Logozzo, Stanley Platoz, and Harry Sanders. A few missing copies came from the files of the Society.

A complete check on the Proceedings is in progress.

Plating Industry Publicity

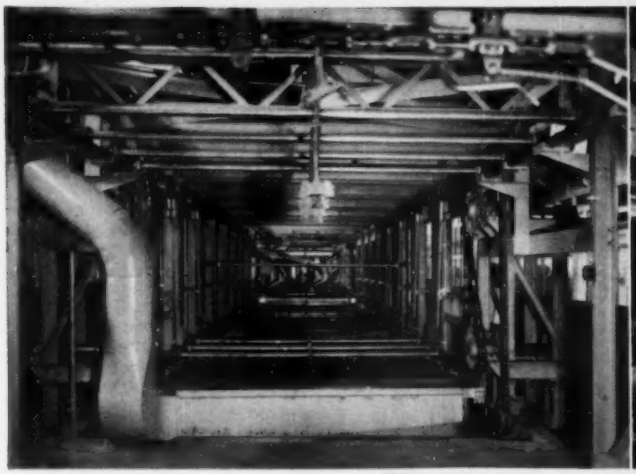
Another report has been received from the Public Relations Committee on its manifold activities. It will be published in a forthcoming issue.

In the meantime, the Committee is anxious to get data about plating applications in defense production during World War II, for use in an article on the potential of the plating industry in the current defense effort. Please describe briefly what you did, and send the information to Mr. W. M. Phillips, General Motors Research Laboratories, 485 W. Milwaukee Avenue, Detroit 2, Mich.

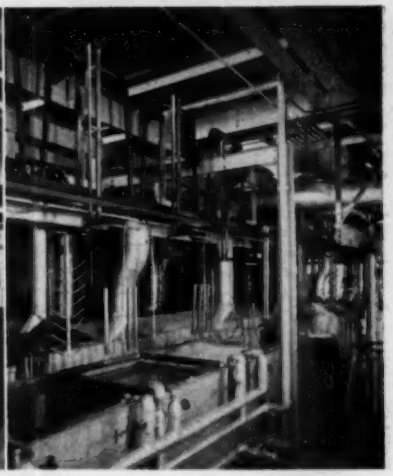
1952 Convention Plans Laid

The 1952 Convention Committee met with the A. E. S. Executive Board at the Stevens Hotel in Chicago on January 27. At the meeting, which was held in conjunction with the Annual Educational Meeting and Banquet of the Chicago Branch, plans were discussed for the 1952 Convention. Those present were (reading clockwise): Art Bartman, Rudy Hazucha, Klem Petrosius and Dr. J. H. Monaweck (President), Chicago Branch; Dick Wooley, Los Angeles Branch; Dr. George Swift, A. E. S. Third Vice-President; C. F. Nixon, A. E. S. First Vice-President; Marion Longfield, Co-Chairman, 1952 Convention; Mrs. Marion Longfield, Ladies' Chairman, 1952 Convention; Paul Glab (Secretary), Chicago Branch; Franklyn MacStoker, A. E. S. Second Vice-President; Clyde Kelly, General Chairman, 1952 Convention; Bill Neill, A. E. S. President; Joe Andrus (Librarian), Chicago Branch; Dr. A. K. Graham, A. E. S. Executive Secretary; Henry Bornitske, Milwaukee Branch; H. A. Gilbertson, Former A. E. S. President; Leonard Weeg, Rockford Branch; William Geissman, Rockford Branch; Dr. H. J. Wiesner, St. Joseph Valley Branch; Harold Faint, Chicago Branch; Ray Ledford, Publicity Chairman, 1952 Convention.

in your plating How to Get Greater Production Improved Quality Better Working Conditions

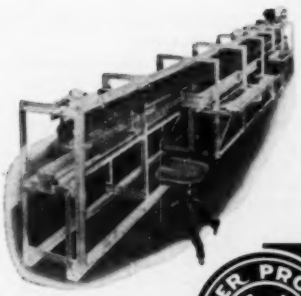


Typical Meaker Straight-A-Way Automatic Plating Machine. This type unit is designed to handle 125 racks or more per hour.



Meaker Return-Type Automatic Plating Machine for chromium-plating the large variety of parts in a high-quality line of plumbing hardware. Machine may be designed to copper plate, nickel plate and chromium plate in one continuous line.

A Meaker Semi-Automatic Plating Machine for use in medium-output plating departments and also for supplementing the plating operations in a Full Automatic which performs the cleaning, preplating operations, final rinsing and drying.



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Branch News

Coming Events

ST. LOUIS BRANCH
SPRING BANQUET
Saturday, April 21
Starlight Roof, Hotel Chase
Tickets at $5.00 from Arthur P. Wriesberg, 2818 La Salle Street, St. Louis 4, Mo.

INDIANAPOLIS BRANCH
ANNUAL EDUCATIONAL SESSION AND DINNER-DANCE
Saturday, April 28
Indianapolis Athletic Club
Educational Session at 2:00 P. M.
Speakers from Aluminum Company of America, Darco Corporation, and United Chromium, Inc.
Dinner-Dance in the Evening
Tickets at $5.00 per person
HOWARD D. PHILLIPS

MILWAUKEE BRANCH
ANNUAL EDUCATIONAL SESSION AND BANQUET
Saturday, April 28
Schroeder Hotel
Symposium
on Finishing for Defense at 2:00 P. M.
Vincent Mattacotti, Chairman
Speakers: DR. WILLIAM BLUM, National Bureau of Standards, "The Effect of War on the Plating Industry"
MR. CARROLL HUTCHISON, Nubian Division, The Glidden Company, "Organic Finishes for the Armed Forces"
MR. MYRON B. DIGGIN, Hanson-Van Winkle-Munning Company, "Plating To Meet Today's Conditions"
Banquet at 7:00 P. M.
Ted Hartshorn, Chairman
Music—Floor Show—Dancing
Tickets at $6.50 per person from Robert Steuernagel, c/o S. K. Williams Company, 2372 N. 32nd Street, Milwaukee, Wis.
KENNETH R. OLSEN,
Publicity Chairman

12TH ANNUAL NEW ENGLAND REGIONAL MEETING
Saturday, April 28
Hotel Taft, New Haven, Conn.
Technical Session at 2:00 P. M.
Speakers: W. D. STAFF, The Lea Manufacturing Company, "N. P. A. Regulations Affecting Plating"
DR. F. A. LOWENHEIM, Metal & Thermit Corporation, "Plating of Tin-Zinc Alloys"
A. D. SQUITTERO, Hanson-Van Winkle-Munning Company, "Iron Plating"
HARRY SANDERS, Enthone, Inc., "Specification Finishing of Aluminum"
Banquet at 7:00 P. M.
Floor Show—Dancing
Tickets from E. V. Collins, Box 127, Bantam, Conn.

ADELAIDE BRANCH

The Branch held its annual Smoke Social on December 12 at the R. S. L. Hall. The meeting was opened by VICE-PRESIDENT J. AUSTIN in the absence of PRESIDENT W. J. PLATTEN, who was visiting America. Mr. Austin read the Presidential Report for 1950.

Refreshments and a band of entertainers made the evening most enjoyable, a fitting climax of a most successful year.

W. FISCHER, *Hon. Secretary*

ADELAIDE BRANCH

At the general meeting held at the University of Adelaide on February 14, films loaned from the library of the C. R. T. S. were viewed, one on "Electrochemistry" and two on "Elementary Electricity". Through the courtesy of the Shell Company of Australia, films of general interest were shown.

W. FISCHER, *Hon. Secretary*

BALTIMORE-WASHINGTON BRANCH

The meeting at the Electrodeposition Section of the National Bureau of Standards on February 13 drew a record turnout, with sixty-three members, wives and guests present. Members at the Bureau had planned the evening and made it an exceedingly interesting one. DR. W. BLUM sounded a note of welcome and gave a preview of the evening's tour. DR. ABNER BRENNER showed his movie on adhesion testing by the nodule method and the equipment used in the procedure; he also demonstrated electroless nickel-plating. DWIGHT COUCH explained the unusual properties of plated nickel- and cobalt-phosphorus coatings and had various samples on display. MRS. COUCH showed the technique of preparing stand-

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ards for Magnegages and the use of these instruments in measuring plate thicknesses. DR. VICTOR ZENTNER exhibited electroformed nickel foils and tubes. JOHN YOUNG showed the pilot-plant installation for internal chromium plating of gun barrels. DR. VERNON LAMB explained the use of special gunbarrel gauges and showed examples of unusual plating work done in the Bureau job shop. Other Branch worthies at the Bureau, including SEYMOUR SENDEROFF, AL POMMER and ASAF BENDERLY, served as guides and answered questions.

The only business taken up at this meeting was the election of officers, with the following voted to serve for the year beginning April 1, 1951:

President—DR. VERNON LAMB
Vice President—GEORGE E. BEST
Secretary—VINCEN J. HUGHES, JR.
Treasurer—VICTOR ZENTNER
Librarian—ASAF A. BENDERLY

GEORGE E. BEST, *Secretary*

BRIDGEPORT BRANCH

Fifty-five members and guests attended the meeting on January 12.

The Branch decided not to be officially connected with the New England Regional Meeting, although many members will be expected to attend.

Future meetings are to be held in the Harry W. Congdon Hall, American Legion Post No. 11, Golden Hill Street. Sandwiches and beer will be served after the meetings at 50 cents per person. The Branch will not request donations for the refreshments from firms.

Two members were transferred, one to Boston and one to New York Branch.

PRESIDENT CHENIS appointed WILLIAM A. EHRENCRONA chairman for the Old Timers Night on February 9.

TECHNICAL CHAIRMAN DICK BARRETT introduced MR. MANSON GLOVER, President of Glover Coating Company, Malden, Mass., who gave an interesting talk about "Tank Coatings and Their Maintenance".

JOSEPH G. STERLING,
Secretary-Treasurer

CHICAGO BRANCH

The Branch held a very successful technical session and banquet in Stevens Hotel on January 27.

The speakers, Dr. Foster D. Snell, Mr. C. F. Nixon, and Dr. Cloyd C. Snavely, with Educational Session Chairman J. M. Andrus

The educational program, at 2:30 P.M., was directed by LIBRARIAN J. M. ANDRUS. MR. C. F. NIXON, of Ternstedt Division, General Motors Corporation, in his talk about "Polishing and Buffing", first showed pictures of his company's operations and then discussed some interesting new finishing developments. One dealt with new combinations of speed and pressure in automatic buffing, the other with finishing in moving composition-water slurry.

DR. FOSTER D. SNELL, of Foster D. Snell, Inc., presented the theory and practice of "Emulsion, Solvent and Alkaline Cleaning", with emphasis on the first-mentioned type. DR. CLOYD C. SNAVELY, of Battelle Memorial Institute, reviewed "Pickling and Bright Dipping".

The banquet at 8:00 P. M. was at-

At the banquet, from left to right, Chicago Branch President Dr. J. H. Monaweck, Dr. Foster D. Snell, Dr. Cloyd C. Snavely, A. E. S. First Vice-President Dr. George P. Swift, A. E. S. Second Vice-President Franklyn J. MacStoker, A. E. S. First Vice-President C. F. Nixon, and A. E. S. President William J. Neill

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tenced by 1,100, the limit set by the committee. The dinner was good, the entertainment unusually excellent, and the dance music pleasing to everyone. In short, this was the best affair ever sponsored by the Branch.

R. F. LEDFORD, *Correspondent*

CINCINNATI BRANCH

Thirty-three members and guests were present for the February 28 meeting, preceded as usual by a fine dinner.

MESSRS. MARTIN, CLABAUGH and NUZUM indicated that they expect to attend the National Convention in Buffalo and were willing to serve as Delegates. The members were advised of the death of FRANK NORDMAN during the past month. A letter of sympathy was sent to MRS. NORDMAN. A preliminary report of the Nominating Committee, W. P. ALBOHN, Chairman; RAYMOND A. BARRY, and WILLIAM D. GORDON, was submitted. Additional nominations may be made at the March meeting, at which time officers will be elected.

The Branch will pay for the annual picnic this year, so that all members may attend without cost. STEWART CHIPMAN agreed to assist repairing and refinishing some of the kitchen equipment used in The Engineering Society kitchen.

The speaker was MR. W. A. LUCE, of The Duriron Company, Dayton, Ohio, who spoke about "Alloys for Handling Corrosive Plating Solutions". First cost in the purchase of equipment for handling corrosive solutions is not a matter of primary consideration, because more expensive equipment often outlasts cheaper equipment. Equipment suppliers have extensive files of information on resistance of alloys to corrosive solutions. Specific examples of various alloys in different copper, nickel and chromium plating solutions were cited, with emphasis on recommended alloys and the amount of corrosion encountered. Test procedures were discussed. Even for minor changes in the chemical composition of a solution, the equipment supplier should be consulted, because such changes may dictate the use of another alloy.

A short discussion period followed the presentation of this paper, which was illustrated with slides. Refreshments were then furnished by the A. T. Wagner Company of Detroit.

EZRA A. BLOUNT, *President*

DAYTON BRANCH

On the night of the regular meeting on February 2, the weather was very bad and the attendance low.

After regular business had been taken care of, the Librarian introduced MR. P. R. LYONS, Manager of Electrical Sales, Hanson-Van Winkle-Munning Company. Because so few were present, Mr. Lyons decided to have a question-and-answer period on his subject, "Plating Room Electrical Equipment". This was followed with the showing of two films on electricity and electrical equipment.

R. M. CLINEHENS, *Secretary*

DETROIT BRANCH

Zero temperature held down the attendance on February 2; however, about 100 members dared the blustery weather to hear MR. T. G. COYLE, Vice-President of United Chromium, Inc., talk on the interesting subject of "Industrial Applications of the Self-Regulating Chromium Solution". Special reference was made to the use of this solution in defense production.

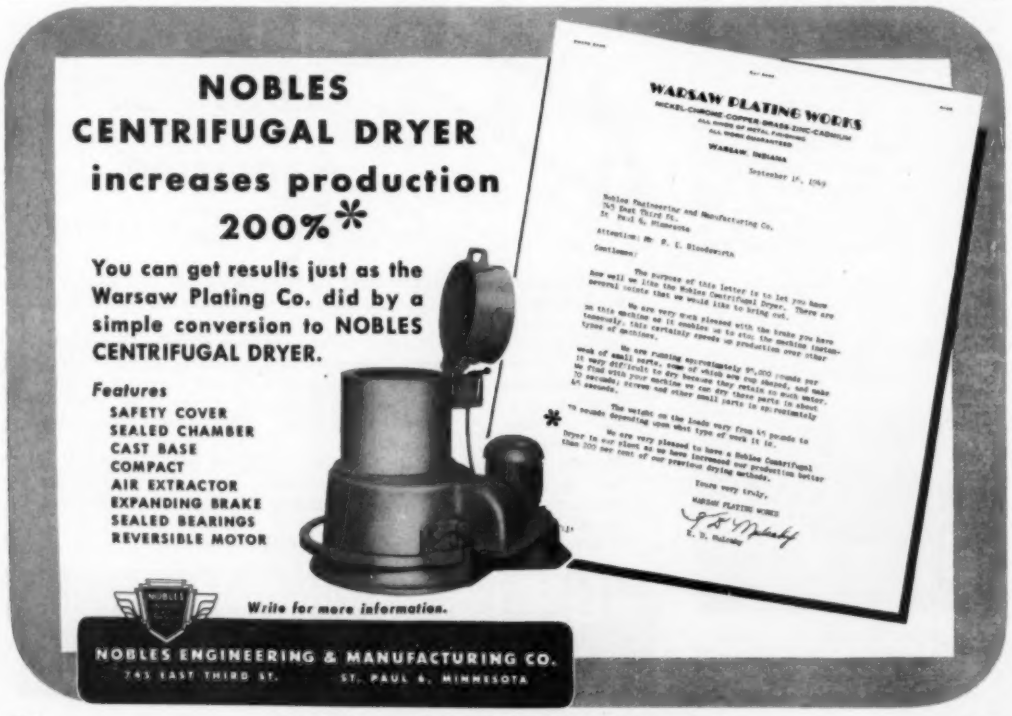
Preceding Dr. Coyle's address, an interesting motion film on plating of aluminum, "Curiosity Shop", was shown.

The meeting was presided over by FRANK L. CLIFTON, Vice-President of the Branch, PRESIDENT ED HAHN being absent because of illness. Several new members were introduced.

E. A. STEEGAR, *Publicity Chairman*

HARTFORD BRANCH

Approximately sixty-five members attended the meeting on February 19. Before the meeting got underway, MR. A. W. LOGOZZO presented a colorful movie, "Hard Chrome Plating", taken at the Nutmeg Chrome Corp. and illustrating anode set-ups for hard-chromium plating.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NICKEL-CHROME-COPPER-BRASS-ZINC-CADMIUM
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September 17, 1949
Noble Engineering and Manufacturing Co.
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Attention: Mr. P. C. Bloodworth
Gentlemen:
The purpose of this letter is to let you know how well we like the Noble Centrifugal Dryer. There are several points that we would like to bring out.
We are very much pleased with the brake you have on this machine as it enables us to stop the machine instantaneously, this certainly speeds up production over other types of machines.
We are running approximately 9,000 rounds per week of small parts, some of which are cup shaped, and make it very difficult to dry because they retain so much water. We find with your machine we can dry these parts to about 50 seconds; screws and other small parts in approximately 45 seconds.
The setsic on the loads vary from 45 seconds to 75 seconds depending upon what type of work it is.
We are very pleased to have a Noble Centrifugal Dryer in our plant as we have increased our production better than 200 per cent of our previous drying methods.
Yours very truly,
WARSAW PLATING WORKS
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Dump your Cadmium Problems

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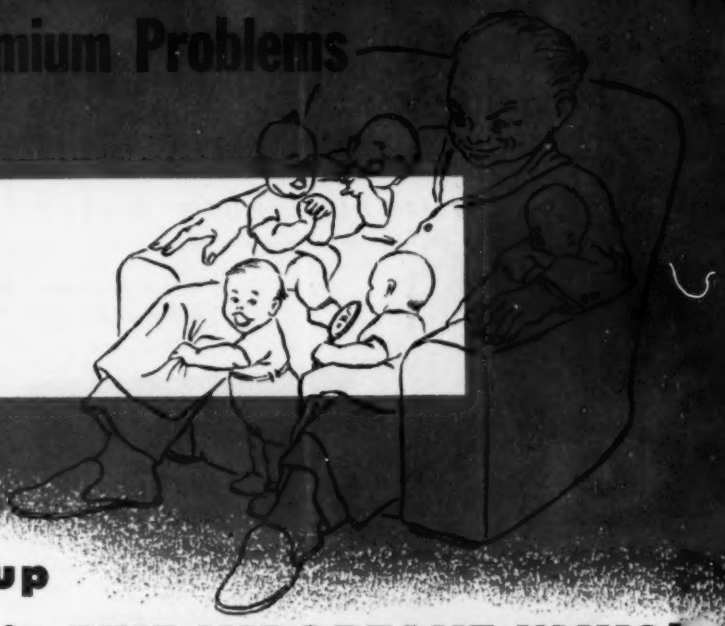

We're set up to relieve you in *FIVE IMPORTANT WAYS!*

Your cadmium plating problems may be with you right now—or they may be just around the corner. Perhaps you're converting from a 'peace time' finish—maybe you're starting on a new defense product which specifies cadmium. Whatever your situation, experienced with cadmium or not, we can help you. For example—

PROBLEM No. 1—Restrictions: If you're all bound up in red tape, can't unravel the latest from Washington, we'll gladly give counsel, the consensus of industry's thinking, interpretations—many right from the mouth of the horse.

PROBLEM No. 2—Metal: We offer you a reliable, *primary* anode source—and Wabrite cadmium, the pure, smooth, bright cadmium ball you can't mistake for any other metal. If your order is rated, we'll ship cadmium till the world looks level.

PROBLEM No. 3—Supplies: We'll start you off right—with our cadmium solution, Wabrite M3X, a three-times concentrated electrolyte, mixed, filtered, purified, plus our proprietary compound.

PROBLEM No. 4—Equipment: We're ready and qualified to set up your complete plating department or any part of it—from tanks, degreasers, rectifiers, barrels, racks to a modern, automatic plating system.

PROBLEM No. 5—Production: Our field engineers are *plating men,* ready to pitch in, keep you going at top efficiency. Our experimental laboratory, pilot plating plant and skilled technicians and metallurgists are at your service.

Get rid of your plating headache! Put in a call to us and we'll have our nearest field engineer rapping on your door. Use the coupon, if you prefer; either way will get sudden action.

Wagner
BROTHERS INC.

Wagner Bros., Inc., 425 Midland, Detroit 3, Michigan

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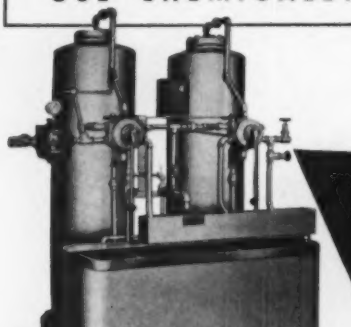

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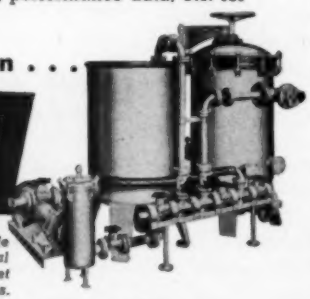

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Branch News

As part of the technical-papers contest, MR. BERNARD COHEN presented a paper on "Barrel Silver Strike". MR. GEORGE HOGABOOM gave a brief talk on latest developments in the plating field.

The principal speaker was MR. WALTER PRINE, of the International Nickel Company, whose subject was "Nickel Plating". Mr. Prine brought out that the five main uses for nickel coatings were: (1) for decorative purposes, of which the biggest portion was employed by the automobile industry; (2) for salvage purposes to reclaim crankshafts, cylinders, and other worn parts; (3) for heavy industrial coatings for corrosion resistance on equipment used by soap, food, plastics, petroleum, etc., industries; (4) in electroforming of electrotypes and phonograph records; (5) on nonconductors for electrical contact, to increase rigidity, and to prevent moisture absorption. The solution composition for each type was given, and samples of plate were exhibited.

GENE DOWLING was technical chairman, and refreshments were served through the courtesy of Apothecaries Hall Company.

STANLEY PLATOZ, *Secretary*

JACKSON-LANSING BRANCH

The branch held a very interesting meeting in Hotel Porter, Lansing, Mich., on February 13.

After entertaining the forty-five members present with a Frankenmuth-style chicken dinner, MR. F. G. WEED, President of the Rinshed-Mason Paint Company, presented 200 excellent three-dimensional pictures taken during his recent trip through Western Europe.

DR. D. T. EWING and L. M. HENDERSON were named Delegates to the Society's Annual Meeting.

FRED W. STUCKENBERG,
Publicity Chairman

LOUISVILLE BRANCH

The regular meeting on February 15 began with the showing of a movie on the mining, smelting and electrolytic refining of copper.

PRESIDENT ALBERT STEIDLE introduced MR. E. W. REHME, of United Chromium Inc., who spoke interestingly about, "Copper Plating from a Pyrophosphate Bath". Although pyrophosphate baths were used as early as 1847, it was not until recently that they were adapted to commercial uses. The copper plate from these baths is soft, fine-grained, easily buffed, and a barrier to gases. Although not classed as a bright plate, it has sufficient luster and requires only light buffing. A cyanide strike is generally recommended on steel, as the bath produces immersion deposits. At 40 asf the efficiency is approximately 100 per cent. Air agitation is recommended. Air and

NEW GLASS FIBER TANKS IDEAL FOR PLATING SOLUTIONS, ACIDS AND MANY CLEANERS

Strong, Light, Economica
PLA-TANK Ⓣ Excellent for Use with Luster-on Ⓡ Zinc Dips

Through the years many materials have been tried in the search for an ideal electroplater's or chemical processing tank. Latest of these is Fiberglas Ⓡ, impregnated and bonded with resins and molded into a seamless one-piece tank.

Sole sales rights on these new tanks for metal finishing, treating and chemical processing have been assigned to Chemical Corporation, 57 Waltham Avenue, Springfield, Mass.

According to the company's Metal Finishing Department, the new PLA-TANK (trademark under which it will be sold) is strong enough for a man to jump on, light enough to be handled easily, resistant to enough acids, plating solutions, emulsion cleaners and similar organic compounds to be highly versatile, inexpensive enough to be very competitive, and available enough to permit standard sizes to be delivered in under thirty days.

PLA-TANK Fiberglas tanks are suggested for most of those uses which have previously required stainless steel, plastic or rubber-lined tanks, acid-proof stoneware or crocks. In case of severe physical damage, the PLA-TANK may be quickly patched on the job in a matter of minutes.

Because of the newness of the product all literature is on a dated bulletin basis with new facts being released as soon as they are reported and verified. Available without cost are general descriptive sheets on PLA-TANKS, list of current sizes and laboratory report on acids and other solutions tested as to corrosive attack.

Chemical Corporation suggests that its PLA-TANKS are specially well suited for holding its LUSTER-ON Bright Dip and newest LUSTER-ON Olive Drab Dip for use on zinc-plated work. These finishes have gained added significance from recent NPA bans on use of cadmium and nickel. Although the Olive Drab is sold for United States Government orders only, the LUSTER-ON Utility-15 and -25 Bright Dips are still being offered for 1951 on an allotment basis to new customers who wish to convert to zinc and Luster-on for their civilian goods.

Free data sheets will be sent to those requesting them and engineering consultation is available for conversions. Inquiries on PLA-TANKS or LUSTER-ON should be addressed to Chemical Corporation, 57 Waltham Avenue, Springfield, Mass.

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heating coils should be of stainless steel or be heavily nickel plated. The bath is very nearly neutral and does not actively attack either zinc or aluminum.

G. H. HILLEBRAND, *Secretary*

MELBOURNE BRANCH

The Sixth Annual General Meeting was held on February 15 at the Melbourne Technical College. The Auditors' Report and Balance Sheet showed that the devaluation of Australian currency had resulted in a financial loss for the year, only partly compensated by the $50 Membership Prize for 1949–1950 which the Branch had won.

The election of office bearers for 1951 resulted as follows:

President—R. D. TAYLOR
First Vice-President—H. I. LITTAUER
Second Vice-President—J. L. PARKER
Secretary-Treasurer—R. H. KELLER
Librarian—H. A. TEAGUE
Board of Managers—J. J. DALE, H. MERTON, G. WALKER

BOB TAYLOR, who had served as President during the latter half of 1950, in reviewing the past year's activities, pointed out that during the year thirty-six new members had been admitted, and Branch membership had risen from 101 to 123. An average attendance of forty-one was obtained at regular Branch meetings, but in addition, large numbers had attended the special lectures given by JOHN DALE on his return from America and a plant visit to Commonwealth Aircraft Corporation. The social program, consisting of the Annual Ball and the Annual Dinner, had been most successful, and thanks were due the Social Committee for their efforts on these occasions. Concluding his report, the President thanked all members of the Branch and of the Committee for their support during 1950. In particular, he thanked John Dale for his work as Secretary-Treasurer during the past three years.

R. H. KELLER, *Hon. Secretary*

MONTREAL BRANCH

The regular monthly meeting on February 6 had an attendance of thirty-three members and guests.

MR. WILLIAM DE MILLE, of Canadian Durex Abrasives Ltd., was the speaker and gave a very complete talk on "Grinding and Polishing with Coated Abrasives". This included full details of the manufacture of belts, their applications, and many case histories showing where the use of belts and backstand idlers had increased production and lowered costs.

The following were elected to office for the coming year:

President—WM. GLOVER
First Vice-President—R. E. GORDON
Second Vice-President—T. A. WILLIS
Third Vice-President—B. T. KELLY
Secretary—L. A. ROBILLARD
Librarian—G. R. KING
Board of Managers—G. R. DAVIDSON,

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1—6000/3000 AMPERE, 6/12 VOLT, **CHARLES J. BOGUE.** Synchronous Motor.

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1—5000/2500 AMPERE, 6/12 VOLT, **EAGER ELECTRIC CO.** Separately Excited. Excellent Condition.

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1—2000/1000 AMPERE, 6/12 VOLT, **A. P. MUNNING "OPTIMUS."** Excellent Condition.

1—1500/750 AMPERE, 6/12 VOLT, **HANSON-VAN WINKLE.** Excellent Condition.

1—1000/500 AMPERE, 6/12 VOLT, **ELECTRIC PRODUCTS CO.** Separately Excited. Excellent Condition.

1—2000 AMPERE, 50 VOLT, **CHANDEYSSON ELECTRIC CO.** ANODIZING UNIT. Synchronous Motor. Full Controls.

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5—**GREEN SELECTROPLATERS**, 1800 AMPERES, 12 VOLTS, for operation on 220 volt, 3 phase, 60 cycle.

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There was one membership application. The Branch voted to send $75.00 to the Canadian Research Fund.

William Glover, *Secretary*

NEWARK BRANCH

The meeting on January 19, with sixty-five members and guests present, opened with the showing of a movie by Westinghouse Electric Corporation illustrating the theory and maintenance of electric commutators.

Six applicants were elected to membership, and one member was granted transfer to the Philadelphia Branch. Horace Smith, George Wagner and Myron Diggin were elected Delegates, with Dr. H. B. Linford and A. P. Munning as alternates.

R. F. Clark, Sr., electroplater for fifty years and a member of the A.E..S. and its predecessor, the National Association of Electroplaters, since their inceptions, was elected an honorary member of the Branch.

John DeVries reported that the very successful Christmas Party on December 16 had enriched the Branch by $503.85.

Librarian Robert Horrocks introduced Mr. Leonard Chesworth, United Carr Fastener Corporation, Cambridge, Mass., who spoke about "Barrel Plating of Steel". He recommended that nickel solutions be purified electrolytically at 1 asf, carbon treated and subjected to continuous filtration. Too high a current density would sometimes lead to poor deposits after chromium plating. Two baths used in conjunction were recommended for zinc plating: a high-speed bath giving dull plate and a lower-speed bath giving bright deposits. Continuous filtration and electrolytic purification at 3 asf were suggested. Production-line samples were displayed. A lively question period followed.

George Wagner, *Secretary*

NEW YORK BRANCH

The Branch held two meetings in January. The first, on January 12, was a closed business meeting, at which one member's resignation was accepted. It was decided to notify the members by letter that an increase in dues would be voted on at the next business meeting.

Two films were then shown: one on mining of gold, and one on atomic energy.

The second meeting, on January 26, was an open meeting, at which members and their guests heard Mr. Fred Keller of the Aluminum Company of America and Mr. George Best of Mutual Chemical Company of America speak on sulfuric acid and chromic acid anodizing of aluminum, respectively.

A lengthy discussion period followed.

Grace Aronson, *Recording Secretary*

PHILADELPHIA BRANCH

The regular meeting on January 26 was a dinner meeting at Mosebach's Restaurant, with thirty-four attending.

President Samuel Heiman introduced the speaker, Mr. W. L. Cassell, The Lea Manufacturing Company, whose topic was "Plating Room Equipment and Layout". Discussed were such important factors as process details, location, floors, lighting, and workers' comfort. The proper layout of still tanks by means of scale floor plans and equipment templates, insulation of electrified equipment, temperature controllers, and location of tank drains with reference to floor drains were also treated, as were power sources, ventilation, barrel-plating equipment and operation, and semi- and full-automatic plating equipment.

D. R. Robson, Branch member and member of the A. E. S. Research Finance Subcommittee, spoke about the present status of the Research Committee finances and urged an active campaign to obtain more sustaining members. Robert Tiers, Chairman of the Branch Research Finance Committee, then outlined the publicity program planned for the Branch, which includes letters, bulletins, and personal visits to prospects. The importance of the cooperation of each member to make a successful campaign was stressed.

The door prize, a cocktail shaker donated by Reynolds-Robson Supply Company, was won by Ralph Wirt. The tentative report of Annual Banquet was read and showed a profit. Four new active members were admitted.

Wm. Marcovitch, *Secretary*

ROCHESTER BRANCH

The speaker on February 19 was Mr. C. Heamon Castle, Technical Director of Roto-Finish Company, whose excellent talk on barrel finishing was augmented

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by some highly revealing color movies of the equipment in action.

WILLIAM HOWARD was the lucky guesser who won an electric clock. Attendance continued its slow rise.

WALTER F. SWANTON, *Secretary*

ROCKFORD BRANCH

The February meeting saw forty-one present for dinner and sixty-two on hand for the educational session.

Committees reported plans completed for the Annual Educational Session and Banquet on March 31.

BILL GEISSMAN introduced the speaker, MR. C. U. WINTERS of the R. O. Hull Company, Cleveland, Ohio. He gave an exceptionally interesting and informative talk on the "Use of the Hull Cell in the Control of Plating Solutions". The high points of his discussion were illustrated with excellent colored slides. Following the talk, Mr. Winters gave actual demonstrations of the equipment, using solutions brought to the meeting by members.

VERN T. WISSEN, *Secretary*

SAGINAW VALLEY BRANCH

The second Annual Ladies' Night Party on February 3 at the Zehnder Hotel, Frankenmuth, Mich., was an outstanding success. The efforts of GENERAL CHAIRMAN ELDON BRISSON were amply repaid when 160 members, guests and wives attended.

Favors, consisting of bone-china cups and saucers, were given to the ladies following the chicken dinner. A very good five-piece band furnished the dance music.

The happy smile of the president of this infant Branch, JOE FARMER, was seen everywhere. It was his idea to send the invitations directly to the members' wives, and it paid dividends. The ladies responded and everyone enjoyed the evening.

Ballots for new officers were announced in the mail. The results will be tabulated prior to the next meeting.

WILMAR W. KAUFMANN,
Recording Secretary

ST. JOSEPH VALLEY BRANCH

Twenty-one members and guests were present for the dinner and twenty-four attended the technical session on February 7.

One applicant was elected to membership, and two applications for membership were received. DR. HAROLD J. WIESNER, RALPH D. WYSONG, and EUGENE ROTH were elected Delegates, and JAMES HEDGES, JOHN LOCKERBIE, and JOHN BAYMAN were chosen to serve as alternates. RALPH D. WYSONG was appointed chairman of the Nominating Committee for the 1951–1952 season.

The Librarian, DR. ERNEST J. WILHELM, introduced the guest speaker, MR. C. H. SAMPLE, of The International Nickel Company, who presented his paper on "Specifications and Tests for Electrodeposited Coatings". After a brief discussion of the current nickel situation, Mr. Sample cited as a background the earliest plating-thickness specifications on record in this country, prepared by Western Electric Company in 1911, and the first tests on deposits, made by the National Bureau of Standards on silver plated ware in 1924. Only since 1935 have there been more or less uniform specifications available to the industry, approved and coordinated by the A. E. S. and A. S. T. M.

The purpose of plating specifications is to describe what is wanted and to supply tests to determine if the plate meets the specifications. Requirements of ideal test specifications are: (1) simple and easy to perform, (2) minimum of time required to obtain results, (3) nondestructive, (4) results to match requirements. A discussion of specification requirements followed, and a description of available tests for thickness, porosity, adhesion, and other qualities of plating were given. A series of colored slides illustrated the difference between results obtained in salt-spray, humidity, and out-door-exposure tests and served to caution all concerned not to jump to conclusions in the interpretation of test results. A question-and-answer period followed.

EUGENE ROTH, *Secretary-Treasurer*

ST. LOUIS BRANCH

A different type of educational meeting was held in January. For the first time in several years the meeting was not held in The York Hotel. Instead ROBERT COULSON, Plating Foreman of the American Fixture & Manufacturing Company, had invited his fellow members to make a tour of his company's new plant on Semple Avenue and had arranged to have dinner served in the plant cafeteria. MR. JOHN NASH, Manager of the KORRECT WAY Division, and MR. IRVIN KEEFER, Manager of the Chrome Craft Division, had helped plan the meeting. One hundred members and thirty-two guests came, the largest attendance the Branch has ever had at a meeting.

The group was taken through the plant and shown its two huge fullautomatic plating machines, each capable of plating a complete dinette set every 45 seconds. Great interest was shown in the many products produced. Production lines are maintained by modern conveyor systems throughout the plant. Each one attending expressed his enthusiasm for this type of meeting, which undoubtedly will be the forerunner of many others.

EDWARD HUNLETH, *Secretary*

ST. LOUIS BRANCH

In spite of the inclement weather, twenty-three members managed to arrive in time for the dinner on February 14.

H. SIEGEL and A. JULIUS reported for the Spring Banquet Committee, with recommendations for the place, price of tickets, orchestra, entertainers, etc. Four candidates were elected members.

LIBRARIAN ROBINS introduced MR. R. H. TIERS of the Pennsylvania Salt Manufacturing Company, who with the assistance of projector slides gave a very interesting and instructive discourse on trouble shooting of alkaline cleaners. A barrage of questions followed, which Mr. Tiers answered very skillfully.

The date for the Spring Banquet is April 21. All members of the Society are extended a cordial invitation to attend.

EDWARD HUNLETH, *Secretary*

SOUTHEASTERN BRANCH

The annual Jacksonville meeting was held on February 9 in the Green Turtle Cafe, Jacksonville, Fla., with twenty members and guests attending, of which ten came from other cities.

The guest speaker, MR. C. C. HELMLE, of Enthone, Inc., was introduced by CLEM HOHNER. Mr. Helmle gave a most interesting talk on cleaners used in the plating industry, according to some, the most educational talk on the subject they had ever heard. He answered all questions asked.

The entire group then went to the Seminole Hotel, where refreshments were served. A general "bull session" lasted well into the wee hours.

WM. T. WEYMOUTH, *Secretary-Treasurer*

SPRINGFIELD BRANCH

Nineteen members and guests were present at the meeting on January 22.

One application for membership was received. JACK COSTIGAN reported on the progress made by the committee for the 12th Regional Meeting to be held in New Haven on April 28. The tentative by-laws which are to govern the actions of the Regional Meetings and the meeting committees were referred to the Board of Managers for study, and a copy is to be sent to MR. MANSON GLOVER of the Boston Branch for criticisms and recommendations.

MR. L. V. GAGNON, Bart-Messing Corporation, Brooklyn, N. Y., gave an informal talk about the use of more efficient methods of plating. He took as examples many of the improvements made at the Gillette Safety Razor Company, which has only about 20 piece parts to plate but plates about 10 million of them per year. Only the best handling and racking keep the cost down to a reasonable and salable figure. Changes in shop layout to reduce handling and to gain close sequence of operations were described, as was the design of a rack to hold large numbers of small parts so that uniform thickness and appearance would be obtained regardless of the position of the piece on the rack.

A social hour followed under the kind auspices of the Hampden Color & Chemical Company.

PHILIP W. PROUTY, *Secretary*

SYDNEY BRANCH

Owing to a misunderstanding on the

part of most members concerning lighting restrictions imposed during a recent coal strike, not enough members arrived for a quorum at the February meeting.

However, all officers except one were present, and a good discussion was held pertaining to the future of the Branch.

W. E. Paterson, *Secretary*

TORONTO BRANCH

The guest speaker on January 12 was Mr. Ralph Shannon of the Diversey Corporation, Chicago. His talk on "How to Choose a Metal Cleaner" was very well received. He suggested tests for almost all important properties, including bath life, wetting ability, and emulsifying properties. The very interesting presentation gave the plater an insight into what he really should look for when buying a metal cleaner. As a result, the cleaner salesmen in this area will have a few more questions to answer in the future.

Cy Short, Chairman of the Branch Research Finance Committee, reports that several sustaining members have been enrolled to support the Canadian Research Project. However, he urges all Canadian A. E. S. members to get behind the project; we are still short of the funds necessary to start the research work.

A. L. Coxhead, *Correspondent*

WATERBURY BRANCH

The New England Regional Meeting will be held on April 28 in Hotel Taft, New Haven, Conn. Waterbury Branch is host, with E. T. Candee chairman of the Committee. New Haven Branch is arranging a program of speakers to provide information about substitute methods of finishing, made necessary by the defense program. One of the feature talks, it is hoped, will be on waste disposal, which is becoming a major problem in New England.

The Branch considered this problem in some detail at the November meeting, at which Mr. William S. Wise, Chief Engineer of the State Water Commission, outlined the problem of stream pollution, advised how the State was cooperating with industry to solve the problem, and gave several examples of successful industrial waste-disposal plants. Dr. B. F. Dodge, Director of A. E. S. Research Project No. 10, reviewed the chemical methods of waste control, especially as it affected the elimination of cyanides.

S. L. Henn, *Secretary*

WATERBURY BRANCH

The early history of the Branch was discussed at the December meeting, when charter members told about the founding of the Branch in 1921. George B. Hogaboom, the first president of the Branch, Harry Johnquest, William Coleman and William J. Gray, with E. T. Candee as moderator, gave details of the early struggle to build up an effective group and brought out many interesting and sometimes humorous incidents.

To carry out the historical theme, Dr. George Dubpernell reviewed a book first published in 1843, "Elements of Electrochemistry", by one of the earliest electrochemists, Antoine Becquerel. In France he has been given credit for the discovery of nickel plating, and in this book he speculated on the possibility of chromium plating.

S. L. Henn, *Secretary*

WATERBURY BRANCH

Dr. George Dubpernell reviewed a French publication, the 1949 volume of "Chrome Dur", at the January meeting. This is a collection of papers from the annual meeting of the Hard Chromium Institute of France.

Mr. Henry Mahlstedt, of United Chromium, Inc., gave a paper on the "Self Regulating Chromium Plating Solution", in which he told how this new bath operates and compared it to the conventional bath.

W. D. Starr is reviewing each month the situation on metal-finishing supplies. His up-to-date analysis of regulations, which limit the supply of needed materials and necessitate changes in methods and finishes, is proving valuable in planning the plating program.

S. L. Henn, *Secretary*

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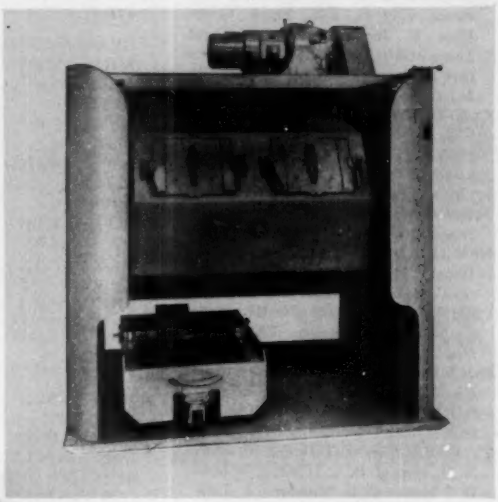

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Tumbling Machine
Single Speed — Variable Speed

Bench Type Tilting
Tumbling Barrel

Jr. Tilting Type
Tumbling Barrel

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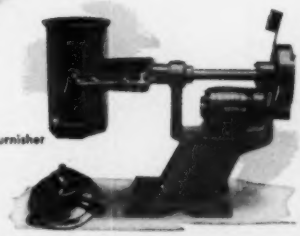

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SYDNEY BRANCH: J. F. Murphy

TWIN CITY BRANCH: Howard C. Jorgensen, Charles Kupelian, John Tobin

Reinstatements

PHILADELPHIA BRANCH: David Halpert

ROCHESTER BRANCH: Ray L. Bolinas

SAGINAW VALLEY BRANCH: Harley Schultz

Transfers

Joseph Mazia from Philadelphia to Baltimore-Washington; Chester Borlet from Detroit; Don P. Volino from Newark; Bernard Agruss to New York; Walter A. Raymond to New York; Gerald Lux from New York; James R. Weaver from Rochester to Houston; Clinton Murray from Rochester to Dallas-Fort Worth

Resignations

ADELAIDE BRANCH: A. M. Curyer, A. Lambert, R. G. Moon

CHICAGO BRANCH: Paul D. Verdow

DETROIT BRANCH: J. M. Mayers

JACKSON-LANSING BRANCH: E. L. Deming, C. C. Bitters

NEW YORK BRANCH: K. K. Miltner

PHILADELPHIA BRANCH: William R. Huey

SYDNEY BRANCH: C. E. Lambert

Membership Competition

BRANCH	Membership* April 1, 1950	New Members	Net Change in Membership	Per Cent Net Change
FIRST GROUP				
GRAND RAPIDS	141	6	+17½	+12.4
MILWAUKEE	124	27	+14½	+11.7
CHICAGO	372	52	+39	+10.5
DETROIT†	483	49	+41	+ 8.5
NEW YORK	280	22	+22½	+ 8.0
BOSTON	142	18	+ 7	+ 4.9
LOS ANGELES	201	30	+ 8	+ 4.8
CLEVELAND	195	34	+ 6	+ 3.1
TORONTO	124	7	+ 3½	+ 2.8
PITTSBURGH	142	6	+ 4	+ 2.8
WATERBURY	125	8	+ 3½	+ 2.8
HARTFORD	132	12	+ 3	+ 2.3
PHILADELPHIA	192	23	+ 4	+ 2.1
BRIDGEPORT	155	9	+ 3	+ 1.9
NEWARK	238	16	+ 1½	+ 0.6
SECOND GROUP				
MONTREAL	68	10	+ 6½	+ 9.6
ST. LOUIS	97	16	+ 9	+ 9.3
MELBOURNE†	111	18	+10	+ 9.0
INDIANAPOLIS	97	14	+ 6½	+ 6.7
BUFFALO	77	8	+ 4	+ 5.2
CINCINNATI	87	5	+ 3	+ 3.4
NEW HAVEN	106	10	+ 2½	+ 2.4
BALTIMORE-WASH.	85	8	+ 1	+ 1.2
SYRACUSE	85	14	− 2	− 2.4
DAYTON	97	1	− 4½	− 4.6
TWIN CITY	71	3	− 5	− 7.0
ADELAIDE	72	7	− 6	− 8.3
PROV.-ATTLEBORO	112	3	−12	−10.7
ROCHESTER	104	9	−15	−14.4
SYDNEY	109	8	−16	−14.7
THIRD GROUP				
ROCKFORD	64	12	+12	+18.8
ALLENTOWN-READING	37	7	+ 6	+16.2
COLUMBUS	47	3	+ 5½	+11.7
ST. JOSEPH VALLEY	66	9	+ 5	+ 7.6
HAMILTON	23	1	+ 1	+ 4.3
WESTERN ONTARIO	23	..	.....	.....
SPRINGFIELD	51	3	− ½	− 1.0
SAN FRANCISCO	66	18	− 1	− 1.5
LANCASTER	62	4	− 2	− 3.2
SOUTHEASTERN†	54	4	− 3	− 5.6
TOLEDO	49	3	− 4	− 8.2
JACKSON-LANSING	57	4	− 5½	− 9.6
LOUISVILLE	25	3	− 2½	−10.0
SAGINAW VALLEY	64	5	− 7	−10.9
OUTSIDE COMPETITION				
AT LARGE	104	27	+ 9	.....
IN TRANSFER	27	..	−19	.....
OTHERS	...	..	+ 9	.....
TOTAL A. E. S.	5,236	559	+143	+ 2.7

Active Membership, March 1, 1951 5,379

*Subject to correction. †Winners of membership competition in 1949–1950.

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ALLENTOWN-READING meets third Wednesday of each month in Spurgeon's Hotel, Allentown, Pa. Secretary-Treasurer, James F. Riegel, 425 S. 18th Street, Allentown, Pa. Research Finance Committee Chairman, William R. Pfeiffer, Jr., 975 Green Street, Allentown, Pa.

BALTIMORE-WASHINGTON meets second Tuesday of each month with meetings in Baltimore at the Engineers' Club and in Washington, D. C., at the National Bureau of Standards. Secretary, George E. Best, c/o Mutual Chemical Company of America, 1348 Block Street, Baltimore 31, Md.

BOSTON meets first Thursday of each month in Hotel Statler. Secretary, Dr. George P. Swift, 53 Galen Street, Watertown 72, Mass. Research Finance Committee Chairman, Eugene P. Carter, c/o United Carr Fastener Corporation, 81 Ames Street, Cambridge, Mass.

BRIDGEPORT meets second Friday of each month in Barnum Hotel. Secretary-Treasurer, Joseph G. Sterling, 134 Colony Street, Bridgeport 8, Conn. Research Finance Committee Chairman, Carl Schaefer, c/o Casco Products Corporation, 512 Hancock Avenue, Bridgeport 5, Conn.

BUFFALO meets first Friday of each month in Markeen Hotel. Secretary, H. A. Fudeman, 534 W. Ferry Street, Buffalo 22, N. Y. Research Finance Committee Chairman, B. P. Fortrim, 200 Forest Drive, Orchard Park, N. Y.

CHICAGO meets second Friday of each month at 8 P. M. at Western Society of Engineers, 84 E. Randolph Street. Secretary-Treasurer, Paul Glab, 882 N. Paulina Street, Chicago, Ill. Research Finance Committee Chairman, R. F. Ledford, c/o Hanson-Van Winkle-Munning Company, 2910 Carroll Avenue, Chicago 12, Ill.

CINCINNATI meets fourth Wednesday of each month at 8 P. M. in Engineering Society Headquarters, McMillan Street and Woodburn Avenue. Secretary, Charles Wise, c/o The Buckeye Products Company, 7020 Vine Street, Cincinnati 16, Ohio.

CLEVELAND meets first Friday of each month in Cleveland Hotel at 8 P. M. Secretary-Treasurer, Harry Pochapsky, 24961 Euclid Avenue, Euclid 17, Ohio. Research Finance Committee Chairman, Howard A. Blouch, 12901 Elmwood Avenue, Cleveland 11, Ohio.

COLUMBUS meets first Friday of each month at 8 P. M. in Battelle Memorial Institute Auditorium. Secretary-Treasurer, Nathan L. Koslin, 2641 Cleveland Avenue, Columbus 11, Ohio. Research Finance Committee Chairman, Fred Brune, R. D. 7, Marion, Ohio.

DAYTON meets first Friday of each month in Engineers Club. Secretary, Richard M. Clinebens, 33 W. Market Street, Germantown, Ohio. Research Finance Committee Chairman, Robert L. Ruleff, 1002 Broadview Blvd., Dayton 9, Ohio.

DETROIT meets first Friday of each month in Hotel Statler. Secretary-Treasurer, Joseph Gurski, 8885 Littlefield, Detroit 28, Mich. Research Finance Committee Chairman, W. B. Knight, c/o Knight Plating Company, 3143 Bellevue Avenue, Detroit 11, Mich.

GRAND RAPIDS meets second Friday of each month at 7:30 P. M. in Rowe Hotel. Secretary, Victor V. Ventoli, 225 Fountain Street, N. E., Grand Rapids, Mich. Research Finance Committee Chairman, John W. Pulte, 308 Gladstone Avenue, S. E., Grand Rapids, Mich.

HAMILTON BRANCH. Secretary, W. Finlay, 7 Hill Street, Hamilton, Ontario, Canada.

HARTFORD meets third Monday of each month in Hotel Bond. Secretary, Stanley Platoz, 26 Erwin Place, New Britain, Conn. Research Finance Committee Chairman, Frank W. Smith, 46 Cottage Street, Meriden, Conn.

INDIANAPOLIS meets first Wednesday of each month at Fox Steak House, 1207 Washington Street. Secretary, Howard Phillips, 1024 Shelby Street, Indianapolis 3, Ind.

JACKSON-LANSING meets second Tuesday of each month alternating between Hayes Hotel in Jackson and Porter Hotel in Lansing. Secretary-Treasurer, E. F. Strefling, 1423 Kelsey Avenue, Lansing 10, Mich.

LANCASTER meets second Friday of each month at 8 P. M. in Thaddeus Stevens Industrial School. Secretary-Treasurer, Harry A. Saylor, 40 N. Poplar Street, Elizabethtown, Pa. Research Finance Committee Chairman, Harry Hovis, Lincoln Highway, West Lancaster, Pa.

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MELBOURNE, AUSTRALIA, meets third Thursday of each month at 8 P. M. in Metallurgy Theatre, Melbourne Technical College, 124 Latrobe Street. Honorary Secretary-Treasurer, Rowland H. Keller, c/o Defence Research Laboratories, Maribyrnong, Victoria, Australia.

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NEWARK meets first and third Fridays of each month at 8 P. M. in Hotel Robert Treat. Secretary-Treasurer, George Wagner, 1130 S. Long Avenue, Hillside, N. J. Research Finance Committee Chairman, Edwin Bowerman, 166–41 17th Avenue, Whitestone, N. Y.

NEW HAVEN meets second Tuesday of each month alternating between Sterling Chemistry Laboratory, Yale University, and Hotel Taft. Secretary-Treasurer, B. J. Gaffney, 40 Filbert Street, Spring Glen, Hamden 14, Conn. Research Finance Committee Chairman, Dr. H. L. Kellner, c/o Lea Manufacturing Company, 16 Cherry Avenue, Waterbury 86, Conn.

NEW YORK meets second and fourth Fridays of each month in Statler Hotel. Secretary-Treasurer, George Schore, 150 Bennett Avenue, New York 33, N. Y. Research Finance Committee Chairman, George F. Hermann, 52 Chestnut Street, Brooklyn 8, N. Y.

PHILADELPHIA meets fourth Friday of each month in Harrison Laboratory Building, University of Pennsylvania, 34th and Spruce Streets. Secretary, I. William Marcovitch, 1434 Lardner Street, Philadelphia 24, Pa. Research Finance Committee Chairman, Robert H. Tiers, c/o Pennsylvania Salt Manufacturing Company, Box 4388, Philadelphia 18, Pa.

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PROVIDENCE-ATTLEBORO meets third Monday of each month in Providence Engineering Society Hall, 195 Angell Street, Providence, R. I. Secretary, Frank W. Boothroyd, 51 Barber Avenue, Apponaug, R. I. Research Finance Committee Chairman, Pierre B. Lonsbury, 78 North Avenue, Attleboro, Mass.

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SAGINAW VALLEY meets for dinner at 7 P. M. and meeting at 8 P. M. at Zenders, Frankenmuth, Mich., second Wednesday of each month, September through May except February. Secretary-Treasurer, Alfred Muehlenbeck, 1141 Beech Street, Saginaw, Mich. Research Finance Committee Chairman, Alfred Knight, 113 S. Farragut St., Bay City, Mich.

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SAN FRANCISCO meets second Thursday of each month, alternating between El Jardin Restaurant, 22 California Street, San Francisco, and El Curtola Restaurant, 510 17th Street, Oakland. Secretary-Treasurer, Roy Fellom, Jr., 709 Mission Street, San Francisco, Calif. Research Finance Committee Chairman, Alan Baker, 10 Bluxome St., San Francisco, Calif.

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